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Experiment 11 - Intermediate code generation- Quadruple, Triple, Indirect Triple

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Aim:

A program to implement Intermediate code generation – Quadruple, Triple, Indirect Triple.

Algorithm:

The algorithm takes a sequence of three-address statements as input. For each three address statements of the form a:= b op c perform the various actions. These are as follows:

1. Invoke a function getreg to find out the location L where the result of computation b op c should be stored.
2. Consult the address description for y to determine y'. If the value of y currently in memory and register both then prefer the register y' . If the value of y is not already in L then generate the instruction MOV y' , L to place a copy of y in L.
3. Generate the instruction OP z' , L where z' is used to show the current location of z. if z is in both then prefer a register to a memory location. Update the address descriptor of x to indicate that x is in location L. If x is in L then update its descriptor and remove x from all other descriptors.
4. If the current value of y or z have no next uses or not live on exit from the block or in register then alter the register descriptor to indicate that after execution of x : = y op z those register will no longer contain y or z.

Code:

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

def infix_to_postfix(formula):
    stack = []
    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()
        else:
            while stack and stack[-1] != '(' and PRI[ch] <= PRI[stack[-1]]:
                output += stack.pop()
            stack.append(ch)
    while stack:
        output += stack.pop()
```

```
    return output

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()
        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)
    while op_stack:
        op = op_stack.pop()
        a = exp_stack.pop()
        b = exp_stack.pop()
        exp_stack.append(op+b+a)
    return exp_stack[-1]

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)

def Quadruple(pos):
    stack = []
    op = []
    x = 1
    for i in pos:
        if i not in OPERATORS:
            stack.append(i)
        elif i == '-':
```

```
            op1 = stack.pop()
            stack.append("t(%s)" % x)
            print("{0:^4s} | {1:^4s} | {2:^4s}|{3:4s}".format(
                i, op1, "(-)", " t(%s)" % x))
            x = x+1
            if stack != []:
                op2 = stack.pop()
                op1 = stack.pop()
                print("{0:^4s} | {1:^4s} | {2:^4s}|{3:4s}".format(
                    "+", op1, op2, " t(%s)" % x))
                stack.append("t(%s)" % x)
                x = x+1
        elif i == '=':
            op2 = stack.pop()
            op1 = stack.pop()
            print("{0:^4s} | {1:^4s} | {2:^4s}|{3:4s}".format(i, op2, "(-)", op1))
        else:
            op1 = stack.pop()
            op2 = stack.pop()
            print("{0:^4s} | {1:^4s} | {2:^4s}|{3:4s}".format(
                i, op2, op1, " t(%s)" % x))
            stack.append("t(%s)" % x)
            x = x+1

def Triple(pos):
    stack = []
    op = []
    x = 0
    for i in pos:
        if i not in OPERATORS:
            stack.append(i)
        elif i == '-':
            op1 = stack.pop()
            stack.append("(%s)" % x)
            print("{0:^4s} | {1:^4s} | {2:^4s}".format(i, op1, "(-)"))
            x = x+1
            if stack != []:
                op2 = stack.pop()
                op1 = stack.pop()
                print("{0:^4s} | {1:^4s} | {2:^4s}".format("+", op1, op2))
                stack.append("(%s)" % x)
                x = x+1
        elif i == '=':
            op2 = stack.pop()
            op1 = stack.pop()
            print("{0:^4s} | {1:^4s} | {2:^4s}".format(i, op1, op2))
        else:
            op1 = stack.pop()
            if stack != []:
                op2 = stack.pop()
                print("{0:^4s} | {1:^4s} | {2:^4s}".format(i, op2, op1))
                stack.append("(%s)" % x)
                x = x+1

def IndirectTriple(pos):
    stack = []
    op = []
```

```
    x = 0
    c = 0
    for i in pos:
        if i not in OPERATORS:
            stack.append(i)
        elif i == '-':
            op1 = stack.pop()
            stack.append("(%s)" % x)
            print("{0:^4s} | {1:^4s} | {2:^4s} | {3:^5d}".format(i, op1, "(-)", c))
            x = x+1
            if stack != []:
                op2 = stack.pop()
                op1 = stack.pop()
                print("{0:^4s} | {1:^4s} | {2:^4s} | {3:^5d}".format(
                    "+", op1, op2, c))
                stack.append("(%s)" % x)
                x = x+1
                c = c+1
        elif i == '=':
            op2 = stack.pop()
            op1 = stack.pop()
            print("{0:^4s} | {1:^4s} | {2:^4s} | {3:^5d}".format(i, op1, op2, c))
            c = c+1
        else:
            op1 = stack.pop()
            if stack != []:
                op2 = stack.pop()
                print("{0:^4s} | {1:^4s} | {2:^4s} | {3:^5d}".format(
                    i, op2, op1, c))
                stack.append("(%s)" % x)
                x = x+1
                c = c+1
    z = 35
    print("Statement|Location")
    for i in range(0, c):
        print("{0:^4d} |{1:^4d}".format(i, z))
        z = z+1

print("=====Quadruple=====")
print("Op   | Src1 | Src2| Res")
Quadruple(pos)
print("=====Tripple=====")
print("Op   | Src1 | Src2")
Triple(pos)
print("====Indirect Tripple====")
print("Op   | Src1 | Src2 |Statement")
IndirectTriple(pos)
```

main.py

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

def infix_to_postfix(formula):
    stack = []
    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()
        else:
            while stack and stack[-1] != '(' and PRI[ch] <= PRI[stack[-1]]:
                output += stack.pop()
            stack.append(ch)
    while stack:
        output += stack.pop()
    return output

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()
        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)
    while op_stack:
        op = op_stack.pop()
        a = exp_stack.pop()
        b = exp_stack.pop()
        exp_stack.append(op+b+a)
    return exp_stack[-1]

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)

def Quadruple(pos):
    stack = []
    op = []
```

```
    x = 1
    for i in pos:
        if i not in OPERATORS:
            stack.append(i)
        elif i == '-':
            op1 = stack.pop()
            stack.append("t(%s)" % x)
            print("{0:^4s} | {1:^4s} | {2:^4s}|{3:4s}".format(
                i, op1, "(-)", " t(%s)" % x))
            x = x+1
            if stack != []:
                op2 = stack.pop()
                op1 = stack.pop()
                print("{0:^4s} | {1:^4s} | {2:^4s}|{3:4s}".format(
                    "+", op1, op2, " t(%s)" % x))
                stack.append("t(%s)" % x)
                x = x+1
        elif i == '=':
            op2 = stack.pop()
            op1 = stack.pop()
            print("{0:^4s} | {1:^4s} | {2:^4s}|{3:4s}".format(i, op2, "(-)", op1))
        else:
            op1 = stack.pop()
            op2 = stack.pop()
            print("{0:^4s} | {1:^4s} | {2:^4s}|{3:4s}".format(
                i, op2, op1, " t(%s)" % x))
            stack.append("t(%s)" % x)
            x = x+1

def Triple(pos):
    stack = []
    op = []
    x = 0
    for i in pos:
        if i not in OPERATORS:
            stack.append(i)
        elif i == '-':
            op1 = stack.pop()
            stack.append("(%s)" % x)
            print("{0:^4s} | {1:^4s} | {2:^4s}".format(i, op1, "(-)"))
            x = x+1
            if stack != []:
                op2 = stack.pop()
                op1 = stack.pop()
                print("{0:^4s} | {1:^4s} | {2:^4s}".format("+", op1, op2))
                stack.append("(%s)" % x)
                x = x+1
        elif i == '=':
            op2 = stack.pop()
            op1 = stack.pop()
            print("{0:^4s} | {1:^4s} | {2:^4s}".format(i, op1, op2))
        else:
            op1 = stack.pop()
            if stack != []:
                op2 = stack.pop()
                print("{0:^4s} | {1:^4s} | {2:^4s}".format(i, op2, op1))
                stack.append("(%s)" % x)
                x = x+1

def IndirectTriple(pos):
    stack = []
    op = []
    x = 0
    c = 0
    for i in pos:
        if i not in OPERATORS:
            stack.append(i)
        elif i == '-':
            op1 = stack.pop()
            stack.append("(%s)" % x)
            print("{0:^4s} | {1:^4s} | {2:^4s} | {3:^5d}".format(i, op1, "(-)", c))
            x = x+1
            if stack != []:
                op2 = stack.pop()
                op1 = stack.pop()
                print("{0:^4s} | {1:^4s} | {2:^4s} | {3:^5d}".format(
                    "+", op1, op2, c))
                stack.append("(%s)" % x)
                x = x+1
                c = c+1
        elif i == '=':
            op2 = stack.pop()
            op1 = stack.pop()
            print("{0:^4s} | {1:^4s} | {2:^4s} | {3:^5d}".format(i, op1, op2, c))
            c = c+1
        else:
            op1 = stack.pop()
```

```
            if stack != []:
                op2 = stack.pop()
                print("{0:^4s} | {1:^4s} | {2:^4s} | {3:^5d}".format(
                    i, op2, op1, c))
                stack.append("(%s)" % x)
                x = x+1
                c = c+1
    z = 35
    print("Statement|Location")
    for i in range(0, c):
        print("{0:^4d} |{1:^4d}".format(i, z))
        z = z+1

print("=====Quadruple=====")
print("Op   | Src1 | Src2| Res")
Quadruple(pos)
print("=====Tripple=====")
print("Op   | Src1 | Src2")
Triple(pos)
print("====Indirect Tripple====")
print("Op   | Src1 | Src2 |Statement")
IndirectTriple(pos)
```

Output:

```
INPUT THE EXPRESSION: (A+B)*(A+B+C)
### THREE ADDRESS CODE GENERATION ###
t1 := A + B
t2 := A + B
t3 := t2 + C
t4 := t1 * t3
=====Quadruple=====
Op   | Src1 | Src2| Res
 +   |  A   |  B  | t(1)
 +   |  A   |  B  | t(2)
 +   | t(2) |  C  | t(3)
 *   | t(1) | t(3)| t(4)
=====Tripple=====
Op   | Src1 | Src2
 +   |  A   |  B
 +   |  A   |  B
 +   | (1)  |  C
 *   | (0)  | (2)
====Indirect Tripple====
Op   | Src1 | Src2 |Statement
 +   |  A   |  B   |   0
 +   |  A   |  B   |   1
 +   | (1)  |  C   |   2
 *   | (0)  | (2)  |   3
Statement|Location
 0   | 35
 1   | 36
 2   | 37
 3   | 38


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

Result:

The program was successfully compiled and run.