CD Assignment 6

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Question:

Implement the following code optimizations on the   input 3-address code in the form of quadruples:
a) Common subexpression elimination
b) Constant folding

Input:

a. Code Optimization:

```
+ y z t1
= t1 x
+ b c t2
= t2 a
+ y z t3
= t3 j
= x b
+ b c t4
= t4 d
* b c t5
= t5 f
+ y z t6
= t6 g
```

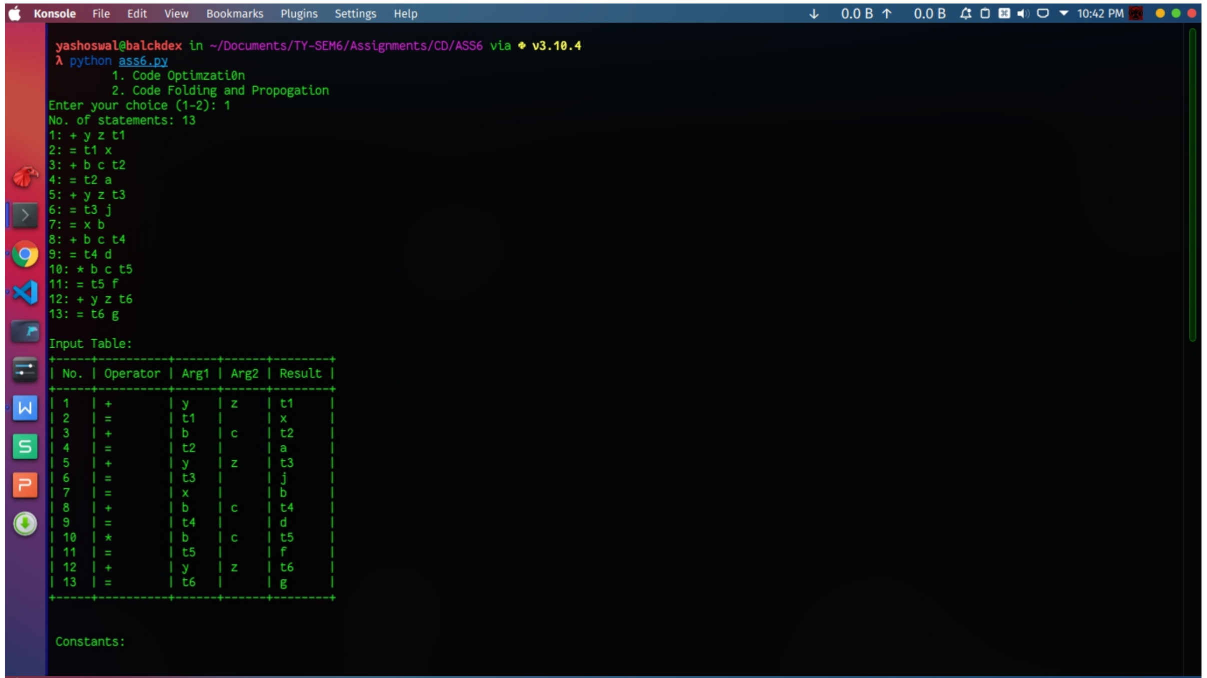
b. Constant folding:

```
 = 30 c
+ y z t1
 = t1 x
+ b c t2
 = t2 a
+ y z t3
 = t3 j
  = x b
 = 20 b
+ b c t4
 = t4 d
* b c t5
 = t5 f
+ y z t6
 = t6 g
```

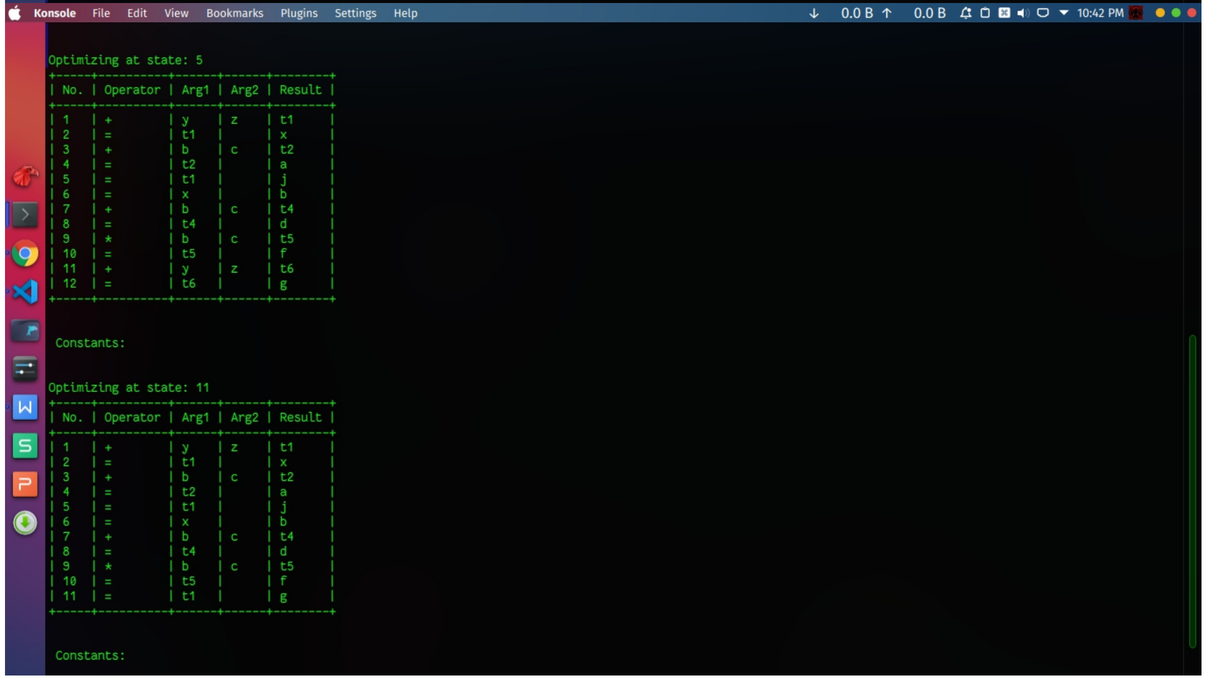
==

Output:

a. Code Optimization

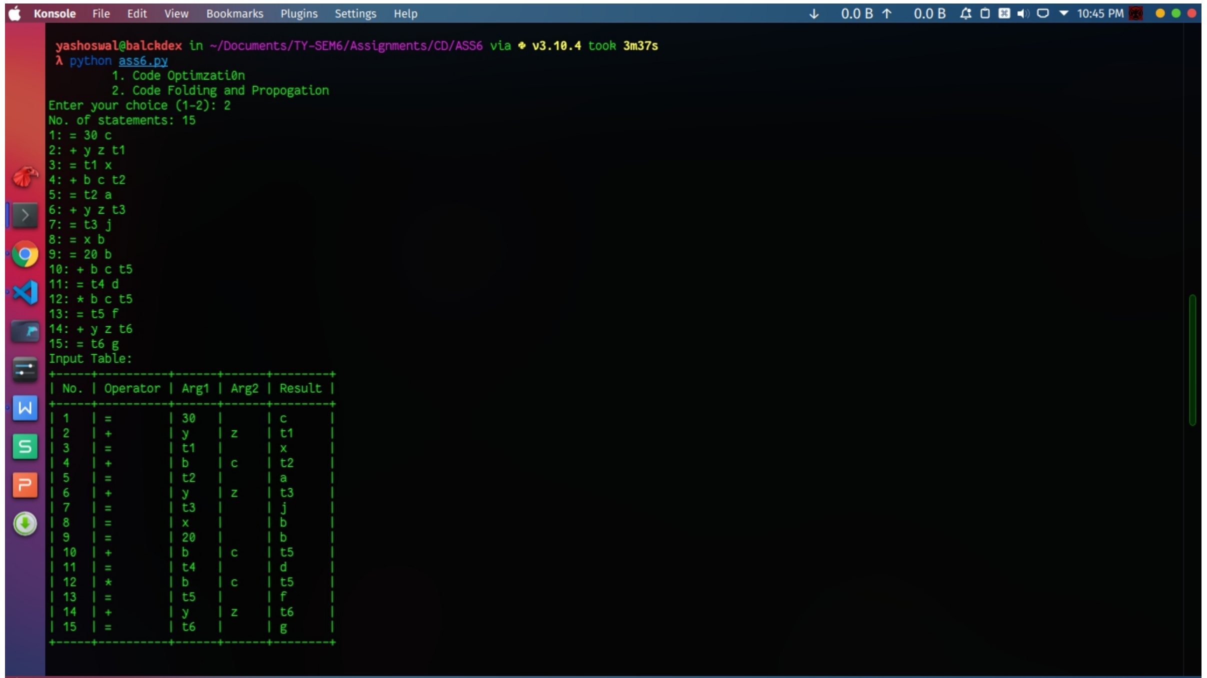


```
yashoswal@balckdex in ~/Documents/TY-SEM6/Assignments/CD/ASS6 via ◆ v3.10.4
λ python ass6.py
        1. Code Optimzati0n
        2. Code Folding and Propogation
Enter your choice (1-2): 1
No. of statements: 13
1: + y z t1
2: = t1 x
3: + b c t2
4: = t2 a
5: + y z t3
6: = t3 j
7: = x b
8: + b c t4
9: = t4 d
10: * b c t5
11: = t5 f
12: + y z t6
13: = t6 g

Input Table:
+-----+----------+------+------+--------+
| No. | Operator | Arg1 | Arg2 | Result |
+-----+----------+------+------+--------+
| 1   | +        | y    | z    | t1     |
| 2   | =        | t1   |      | x      |
| 3   | +        | b    | c    | t2     |
| 4   | =        | t2   |      | a      |
| 5   | +        | y    | z    | t3     |
| 6   | =        | t3   |      | j      |
| 7   | =        | x    |      | b      |
| 8   | +        | b    | c    | t4     |
| 9   | =        | t4   |      | d      |
| 10  | *        | b    | c    | t5     |
| 11  | =        | t5   |      | f      |
| 12  | +        | y    | z    | t6     |
| 13  | =        | t6   |      | g      |
+-----+----------+------+------+--------+


 Constants:
```

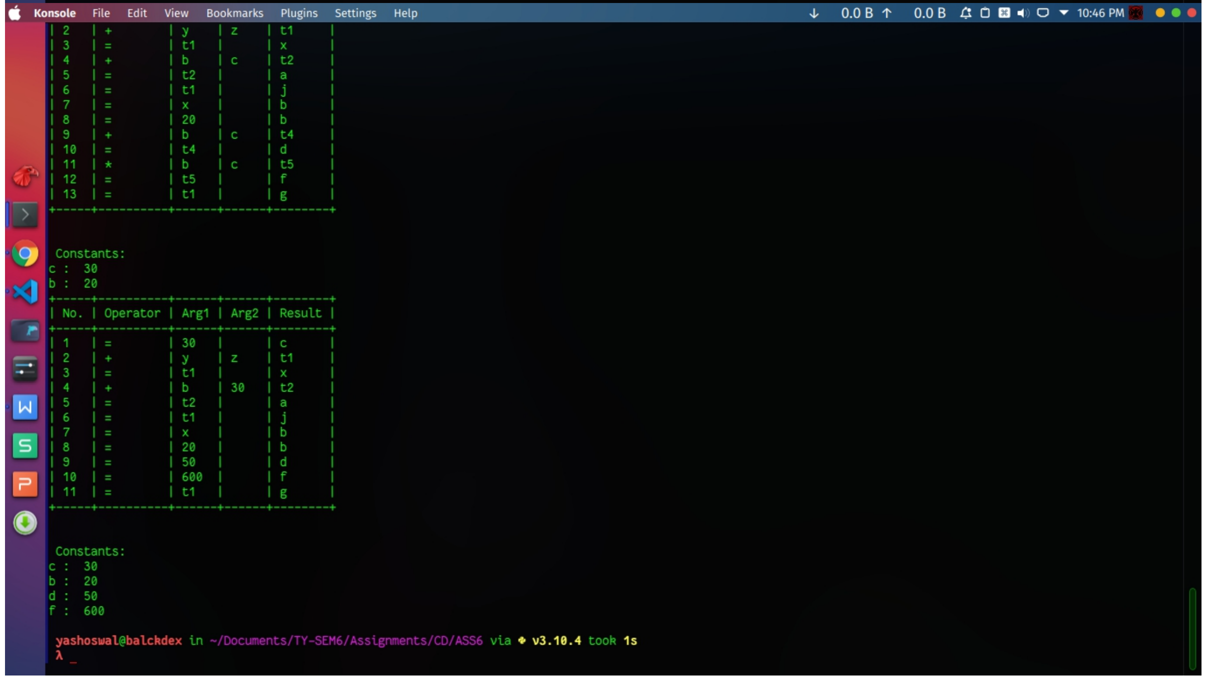


```
Optimizing at state: 5
+-----+----------+------+------+--------+
| No. | Operator | Arg1 | Arg2 | Result |
+-----+----------+------+------+--------+
| 1   | +        | y    | z    | t1     |
| 2   | =        | t1   |      | x      |
| 3   | +        | b    | c    | t2     |
| 4   | =        | t2   |      | a      |
| 5   | =        | t1   |      | j      |
| 6   | =        | x    |      | b      |
| 7   | +        | b    | c    | t4     |
| 8   | =        | t4   |      | d      |
| 9   | *        | b    | c    | t5     |
| 10  | =        | t5   |      | f      |
| 11  | +        | y    | z    | t6     |
| 12  | =        | t6   |      | g      |
+-----+----------+------+------+--------+


 Constants:

Optimizing at state: 11
+-----+----------+------+------+--------+
| No. | Operator | Arg1 | Arg2 | Result |
+-----+----------+------+------+--------+
| 1   | +        | y    | z    | t1     |
| 2   | =        | t1   |      | x      |
| 3   | +        | b    | c    | t2     |
| 4   | =        | t2   |      | a      |
| 5   | =        | t1   |      | j      |
| 6   | =        | x    |      | b      |
| 7   | +        | b    | c    | t4     |
| 8   | =        | t4   |      | d      |
| 9   | *        | b    | c    | t5     |
| 10  | =        | t5   |      | f      |
| 11  | =        | t1   |      | g      |
+-----+----------+------+------+--------+


 Constants:
```

b. Constant Folding



```
yashoswal@balckdex in ~/Documents/TY-SEM6/Assignments/CD/ASS6 via ⬥ v3.10.4 took 3m37s
λ python ass6.py
        1. Code Optimzati0n
        2. Code Folding and Propogation
Enter your choice (1-2): 2
No. of statements: 15
1: = 30 c
2: + y z t1
3: = t1 x
4: + b c t2
5: = t2 a
6: + y z t3
7: = t3 j
8: = x b
9: = 20 b
10: + b c t5
11: = t4 d
12: * b c t5
13: = t5 f
14: + y z t6
15: = t6 g
Input Table:
+-----+----------+------+------+--------+
| No. | Operator | Arg1 | Arg2 | Result |
+-----+----------+------+------+--------+
| 1   | =        | 30   |      | c      |
| 2   | +        | y    | z    | t1     |
| 3   | =        | t1   |      | x      |
| 4   | +        | b    | c    | t2     |
| 5   | =        | t2   |      | a      |
| 6   | +        | y    | z    | t3     |
| 7   | =        | t3   |      | j      |
| 8   | =        | x    |      | b      |
| 9   | =        | 20   |      | b      |
| 10  | +        | b    | c    | t5     |
| 11  | =        | t4   |      | d      |
| 12  | *        | b    | c    | t5     |
| 13  | =        | t5   |      | f      |
| 14  | +        | y    | z    | t6     |
| 15  | =        | t6   |      | g      |
+-----+----------+------+------+--------+
```



```
| 2   | +        | y    | z    | t1     |
| 3   | =        | t1   |      | x      |
| 4   | +        | b    | c    | t2     |
| 5   | =        | t2   |      | a      |
| 6   | =        | t1   |      | j      |
| 7   | =        | x    |      | b      |
| 8   | =        | 20   |      | b      |
| 9   | +        | b    | c    | t4     |
| 10  | =        | t4   |      | d      |
| 11  | *        | b    | c    | t5     |
| 12  | =        | t5   |      | f      |
| 13  | =        | t1   |      | g      |
+-----+----------+------+------+--------+


 Constants:
c :  30
b :  20
+-----+----------+------+------+--------+
| No. | Operator | Arg1 | Arg2 | Result |
+-----+----------+------+------+--------+
| 1   | =        | 30   |      | c      |
| 2   | +        | y    | z    | t1     |
| 3   | =        | t1   |      | x      |
| 4   | +        | b    | 30   | t2     |
| 5   | =        | t2   |      | a      |
| 6   | =        | t1   |      | j      |
| 7   | =        | x    |      | b      |
| 8   | =        | 20   |      | b      |
| 9   | =        | 50   |      | d      |
| 10  | =        | 600  |      | f      |
| 11  | =        | t1   |      | g      |
+-----+----------+------+------+--------+


 Constants:
c :  30
b :  20
d :  50
f :  600

yashoswal@balckdex in ~/Documents/TY-SEM6/Assignments/CD/ASS6 via ⬥ v3.10.4 took 1s
λ _
```

Code:

```
class CodeOptimization():
    quadrapleTable = []
    noOfStatements = 0
    result = []
    constants = {}
    def takeInput(self) -> None:
        state = []
        self.noOfStatements = int(input('No. of statements: '))
        for i in range(self.noOfStatements):
            a = input(f"{i+1}: ")
            state.append(a)
        self.makeQudraple(state)

    def makeQudraple(self,inputStates:list) -> None:
        self.noOfStatements = len(inputStates)
        for n in range(self.noOfStatements):
            var = inputStates[n].split(' ')
            if len(var) == 4:
                self.quadrapleTable.append([n+1, var[0], var[1], var[2], var[3]])
            elif len(var)== 3:
                self.quadrapleTable.append([n+1, var[0], var[1], "  ", var[2]])
                if var[1].isnumeric():
                    self.constants.update({var[2]:[var[1],n]})


    def optimize(self) -> None:
        self.result.append(self.quadrapleTable[0][4])
        n=1
        self.result.clear()
        self.result.append(self.quadrapleTable[0][4])
        while(1):
            if n >= self.noOfStatements:
                return
            for i in range(n-1,-1,-1):
                if (self.quadrapleTable[n][1] == self.quadrapleTable[i][1] and #
                (self.quadrapleTable[n][2] == self.quadrapleTable[i][2] or self.quadrapleTable[n][2] ==
self.quadrapleTable[i][3]) and
                (self.quadrapleTable[n][3] == self.quadrapleTable[i][3] or self.quadrapleTable[n][2] ==
self.quadrapleTable[i][2])):

                if self.quadrapleTable[n][2] not in self.result and self.quadrapleTable[n][3] !=
self.quadrapleTable[i][4]:
                    print(f'\n\nOptimizing at state: {n+1}')
                    self.quadrapleTable.pop(n)
                    self.noOfStatements-=1
                    self.quadrapleTable[n][2] = self.quadrapleTable[i][4]
                    s.printQuadTable()
            self.result.append(self.quadrapleTable[n][4])
            n+=1

    def constantFoldingAndPropogation(self):
        self.result.clear()
        self.result.append(self.quadrapleTable[0][4])
        n=1
        while(1):
            if n >= self.noOfStatements:
                return
            for i in range(n-1,-1,-1):
                if self.quadrapleTable[i][2] in self.constants.keys() and i >=
self.constants.get(self.quadrapleTable[i][2])[1]:
                    self.quadrapleTable[i][2] = str(self.constants.get(self.quadrapleTable[i][2])[0])
                if self.quadrapleTable[i][3] in self.constants.keys() and i >=
self.constants.get(self.quadrapleTable[i][3])[1]:
                    self.quadrapleTable[i][3] = str(self.constants.get(self.quadrapleTable[i][3])[0])
                if self.quadrapleTable[i][1] in ['+','-','/','*','%'] and self.quadrapleTable[i][2].isnumeric() and
self.quadrapleTable[i][3].isnumeric():
                    if self.quadrapleTable[i][1] == '+':
                        sum = int(self.quadrapleTable[i][2]) + int(self.quadrapleTable[i][3])
                        self.quadrapleTable.remove(self.quadrapleTable[i])
                        self.quadrapleTable[i][2] = str(sum)
                        self.constants.update({self.quadrapleTable[i][4]:[(self.quadrapleTable[i][2]),i]})
                        self.noOfStatements-=1
            if self.quadrapleTable[i][1] == '*':
                sum = int(self.quadrapleTable[i][2]) * int(self.quadrapleTable[i][3])
                self.quadrapleTable.remove(self.quadrapleTable[i])
                self.quadrapleTable[i][2] = str(sum)
                self.constants.update({self.quadrapleTable[i][4]:[(self.quadrapleTable[i][2]),i]})
                self.noOfStatements-=1
            if self.quadrapleTable[i][1] == '/':
                sum = int(self.quadrapleTable[i][2]) / int(self.quadrapleTable[i][3])
                self.quadrapleTable.remove(self.quadrapleTable[i])
                self.quadrapleTable[i][2] = str(sum)
                self.constants.update({self.quadrapleTable[i][4]:[(self.quadrapleTable[i][2]),i]})
                self.noOfStatements-=1
            if self.quadrapleTable[i][1] == '%':
                sum = int(self.quadrapleTable[i][2]) % int(self.quadrapleTable[i][3])
                self.quadrapleTable.remove(self.quadrapleTable[i])
                self.quadrapleTable[i][2] = str(sum)
                self.constants.update({self.quadrapleTable[i][4]:[(self.quadrapleTable[i][2]),i]})
                self.noOfStatements-=1
        if self.quadrapleTable[i][2].isnumeric() and self.quadrapleTable[i][1] == '=':
            self.constants.update({self.quadrapleTable[i][4]:[int(self.quadrapleTable[i][2]),i]})
            break
    n+=1

def printQuadTable(self) -> None:
    print('+-----+----------+-----+-----+--------+')
    print('| No. | Operator | Arg1 | Arg2 | Result |')
    print('+-----+----------+-----+-----+--------+')
    for n in range(self.noOfStatements):
        print("| {:<4}| {:<9}| {:<5}| {:<5}| {:<7}|".format(
            n+1,
            self.quadrapleTable[n][1],
            self.quadrapleTable[n][2],
            self.quadrapleTable[n][3],
            self.quadrapleTable[n][4],
        ))
    print('+-----+----------+-----+-----+--------+')
    print("\n\n Constants:")
```

```
      for i in self.constants.keys():
         print(i,": ",self.constants.get(i)[0])

#__main__()
s = CodeOptimization()
print("\t 1. Code Optimzati0n")
print("\t 2. Code Folding and Propogation")
ch = int(input("Enter your choice (1-2): "))
if ch==1:
   s.takeInput()
   print("\nInput Table: ")
   s.printQuadTable()
   s.optimize()
elif ch == 2:
   s.takeInput()
   print("Input Table: ")
   s.printQuadTable()
   s.optimize()
   s.constantFoldingAndPropogation()
   s.printQuadTable()
else:
   print("Enter Valid Choice")
   exit(1)
```