

Code-1:

Compilers

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CSE-D

305

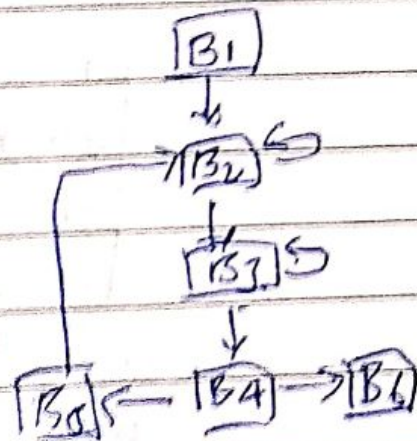
$i = m - 1$
 $j = n$
 B_1 $t_1 = 4 * i$
 $P = a[t_1]$

$i = i + 1$
 $t_2 = 4 * i$
 $t_3 = a[t_2]$
 $\text{if } t_3 < P \text{ goto } B_2$

$j = j - 1$
 $t_4 = 4 * j$
 $t_5 = a[t_4]$
 $\text{if } t_5 > P \text{ goto } B_3$

B_4 $\text{if } i > j \text{ goto } B_6$

$t_{11} = 4 * i$
 $t_{12} = a[t_{11}]$
 $t_{13} = 4 * j$
 $t_{14} = a[t_{13}]$
 $a[t_{12}] = t_{14}$
 $t_{15} = 4 * n$
 $a[t_{15}] = t$



$t_6 = 4 * i$
 $t = a[t_6]$
 B_6 $t_7 = 4 * j$
 $t_8 = 4 * j$
 $t_9 = a[t_8]$
 $a[t_7] = t_9$
 $t_{10} = 4 * j$
 $a[t_{10}] = t$
 $\text{goto } B_2$

Replacing
 goto with Block nos

Dead code elimination for t_7 to t_{12} t_{15}

$t_6 = a[i]$

$t = a[t_6]$

$t_8 = a[i]$

$t_9 = a[t_8]$

$a[t_6] = t_9$

$a[t_8] = t$

goto B₂

$t_{11} = a[1]$

$t = a[t_{11}]$

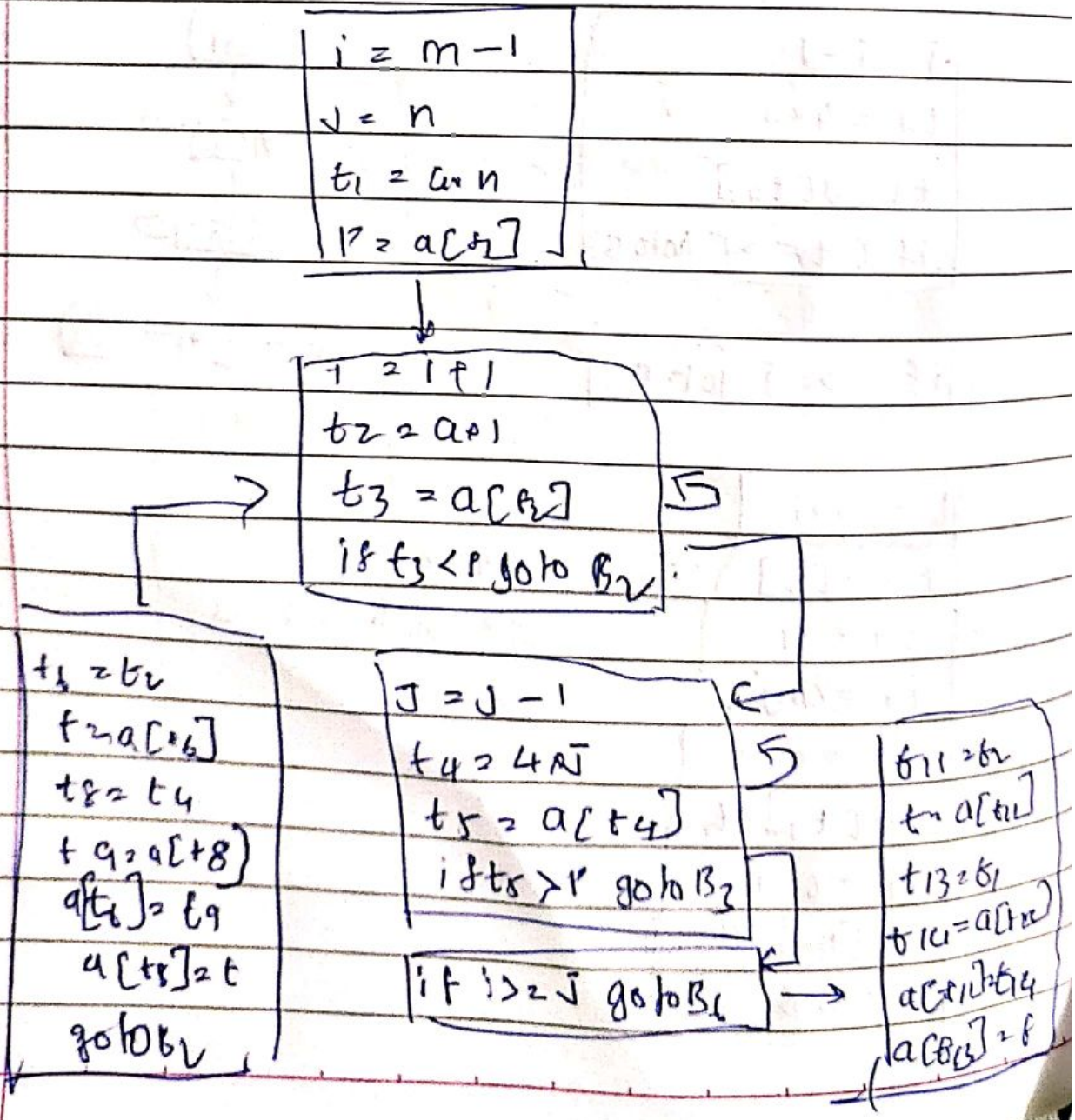
$t_{13} = a[h]$

$t_{14} = a[t_{13}]$

$a[t_{11}] = t_{14}$

$a[t_{13}] = t$

Global Common Subexpression
elimination



Copy propagation on t_6 t_8 t_{11} t_{13}

$$t_6 = t_2$$

$$t = a[t_2]$$

$$t_8 = t_4$$

$$t_9 = a[t_4]$$

$$a[t_1] = t_9$$

$$a[t_4] = t$$

goto B₂

$$t_{11} = t_2$$

$$t = a[t_2]$$

$$t_{13} = t_1$$

$$t_{14} = a[t_1]$$

$$a[t_2] = t_{14}$$

$$a[t_1] = t$$

Dead code elimination on t_6 t_8 t_{11} t_{13}

B₁

$$t = a[t_2]$$

$$t_9 = a[t_4]$$

$$a[t_1] = t_9$$

$$a[t_4] = t$$

goto B₂

B₁

$$t = a[t_2]$$

$$t_{14} = a[t_1]$$

$$a[t_2] = t_{14}$$

$$a[t_1] = t$$

Global Common Subexpression Elimination

```
i = m-1  
t = n  
t = a[i]  
p = a[t]
```

```
j = i+1  
t2 = a[j]  
t3 = a[t2]  
if t3 < p goto B2
```

```
j = j+1  
t4 = a[j]  
t5 = a[t4]  
if t5 > p goto B3
```

```
if i >= j goto B6  
t = t3  
t9 = t5  
a[t2] = t9  
a[t4] = t  
goto B2  
t = t3  
t14 = p  
a[t2] = t14  
a[t4] = t
```


Copy propagation on t_2, t_3, t_4

B5

$t_2 = t_3$

$t_4 = t_5$

$a[t_2] = t_3$

goto B2

B6

$t_2 = t_3$

$t_4 = P$

$a[t_2] = P$

$a[t_1] = t_3$

Dead code elimination on t_2, t_4, t_1

B5

$a[t_2] = t_5$

$a[t_1] = t_3$

goto B2

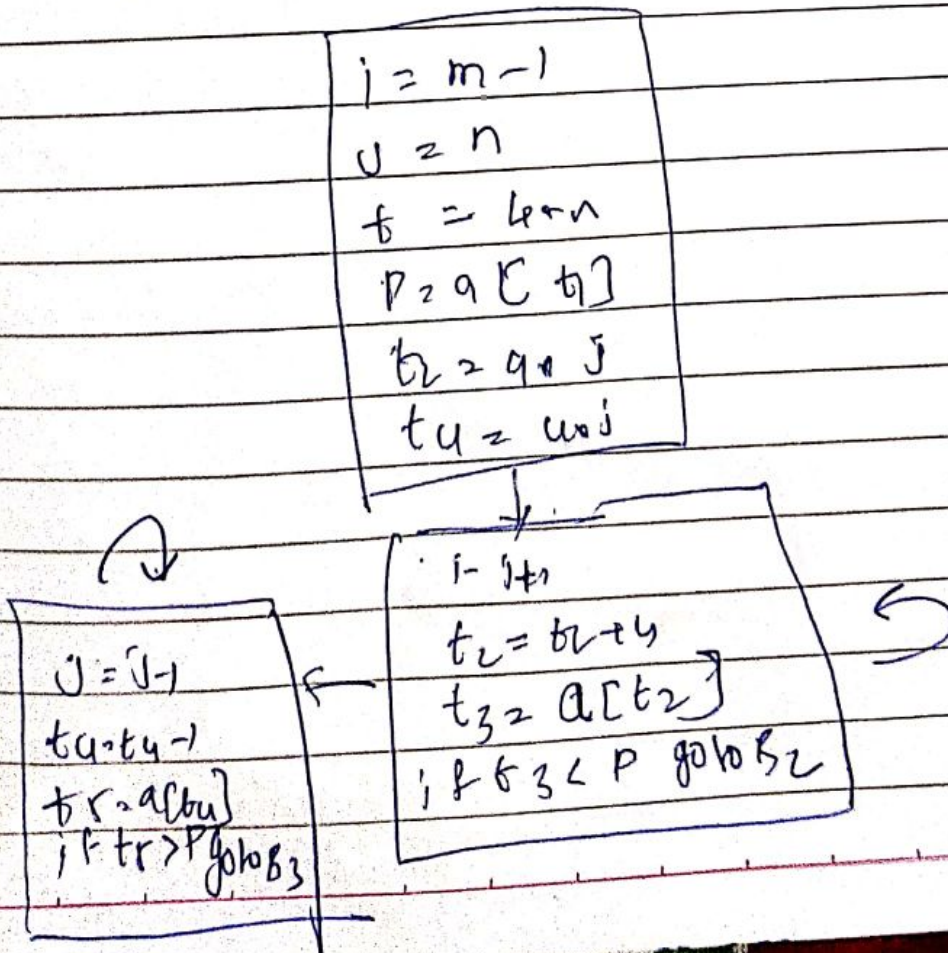
B6

$a[t_2] = P$

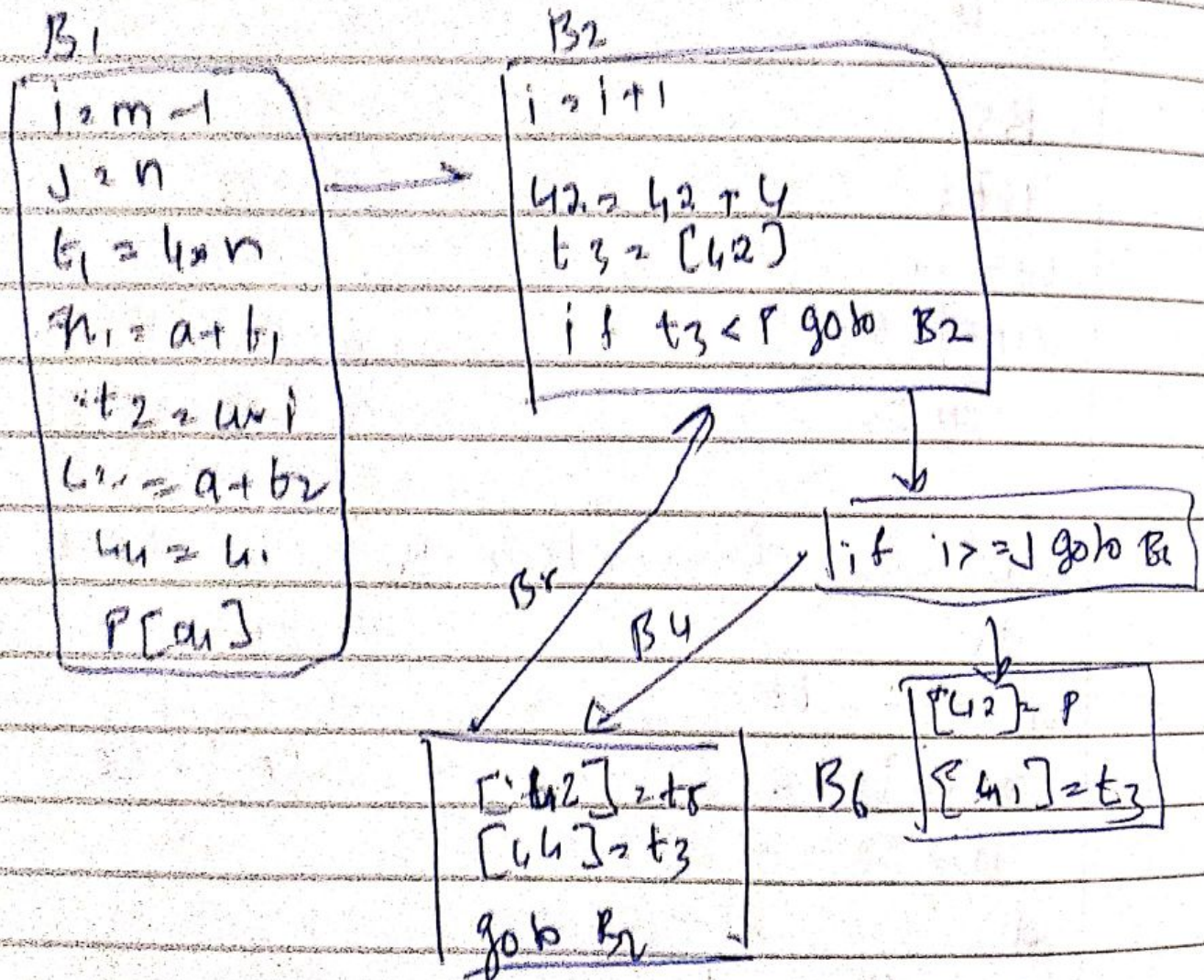
$a[t_1] = t_3$

Q

Strength reduction



Induction variables



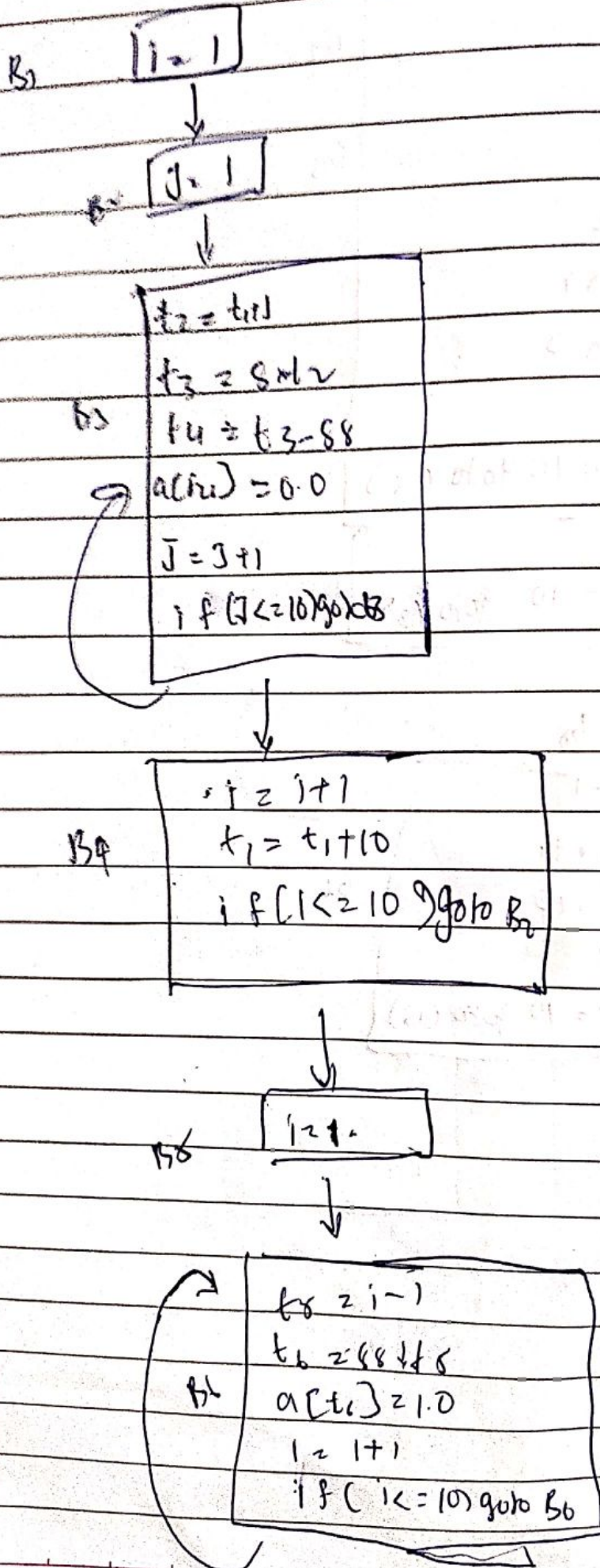
Code 2

1)	$i = 1$	B_1
2)	$j = 1$	B_2
3)	$t_1 = 10 \times i$	
4)	$t_2 = t_1 + j$	B_3
5)	$t_3 = 8 \times t_2$	
6)	$t_4 = t_3 - 8$	
7)	$a[t_4] = 0.0$	
8)	$j = j + 1$	
9)	if $j <= 10$ goto (3)	
10)	$i = i + 1$	
11)	if $i <= 10$ goto (2)	B_4

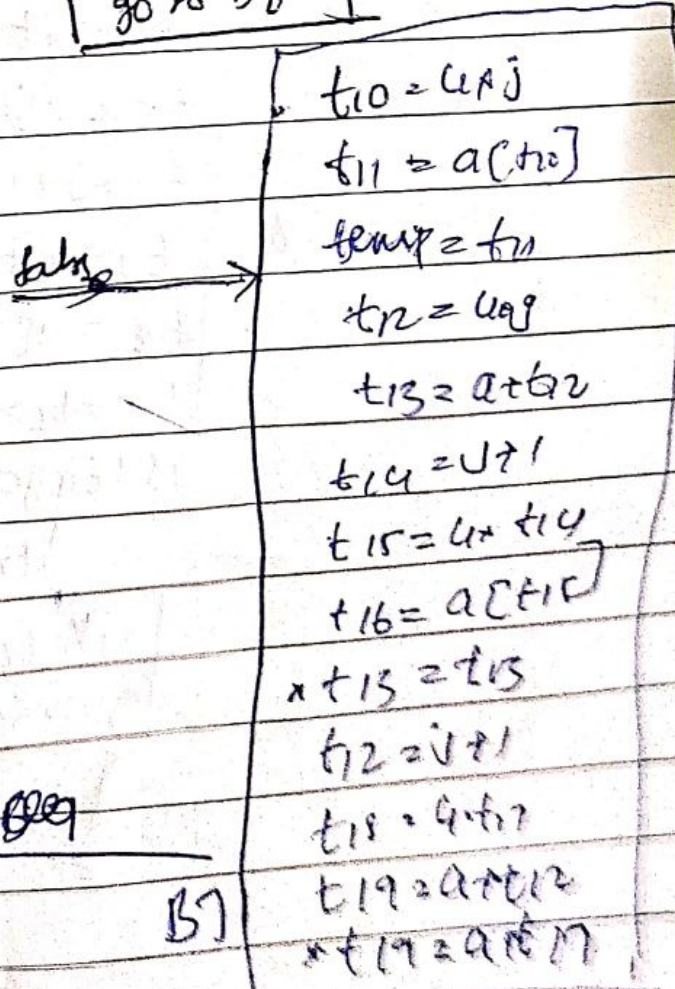
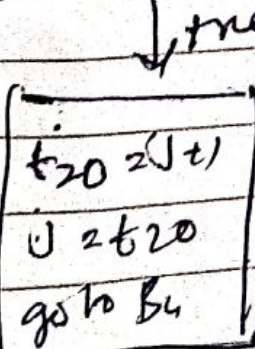
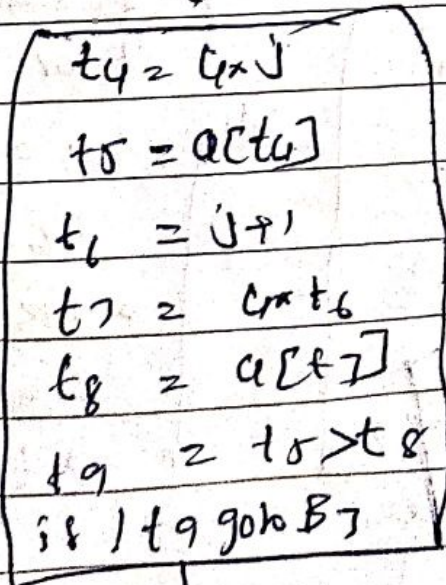
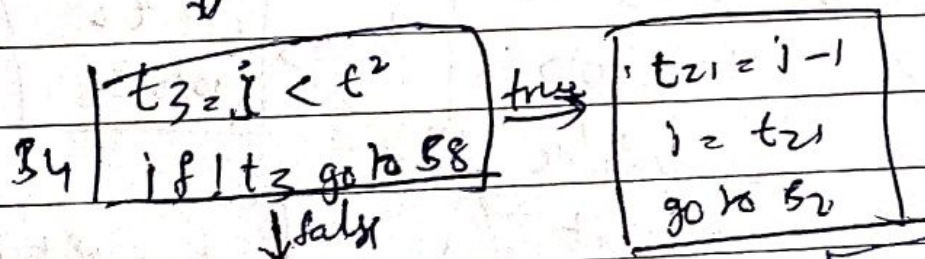
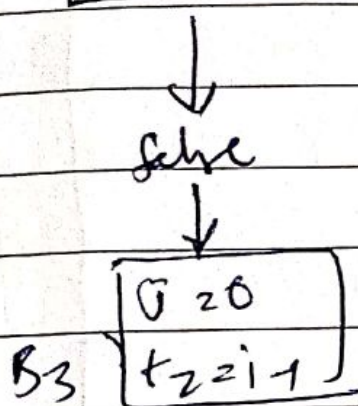
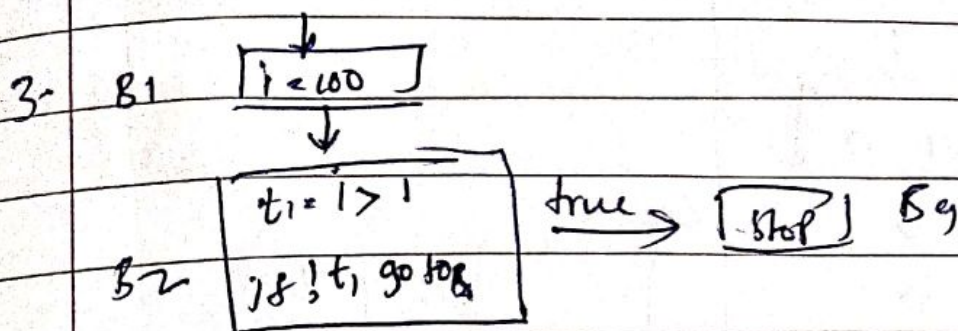
12) $i < 1$ B_5

13)	$t_5 = i - 1$	
14)	$t_6 = \text{for } t_5$	B_6
15)	$a[t_6] = 10$	
16)	$i = i + 1$	
17)	if $i <= 10$ goto (13)	

after eliminating induced variables



Code-3



Global Common Sub-expression elimination

B₁

i = 100

B₂

t₁ = i
if ! t₁ goto B₉

true [NOP] B₉

false

B₃

j = 10
t = i - 1

↓

B₄

t₃ = i < t₂
if ! t₃ goto B₈

true t₂ = t₂
i = t₂
goto B₂

false

B₅

t₄ = a[i]
t₅ = a[t₄]
t₆ = 0 + 1
t₇ = a[t₆]
t₈ = a[t₇]
if t₄ * t₅ > t₈
if ! t₉ goto B₇

false

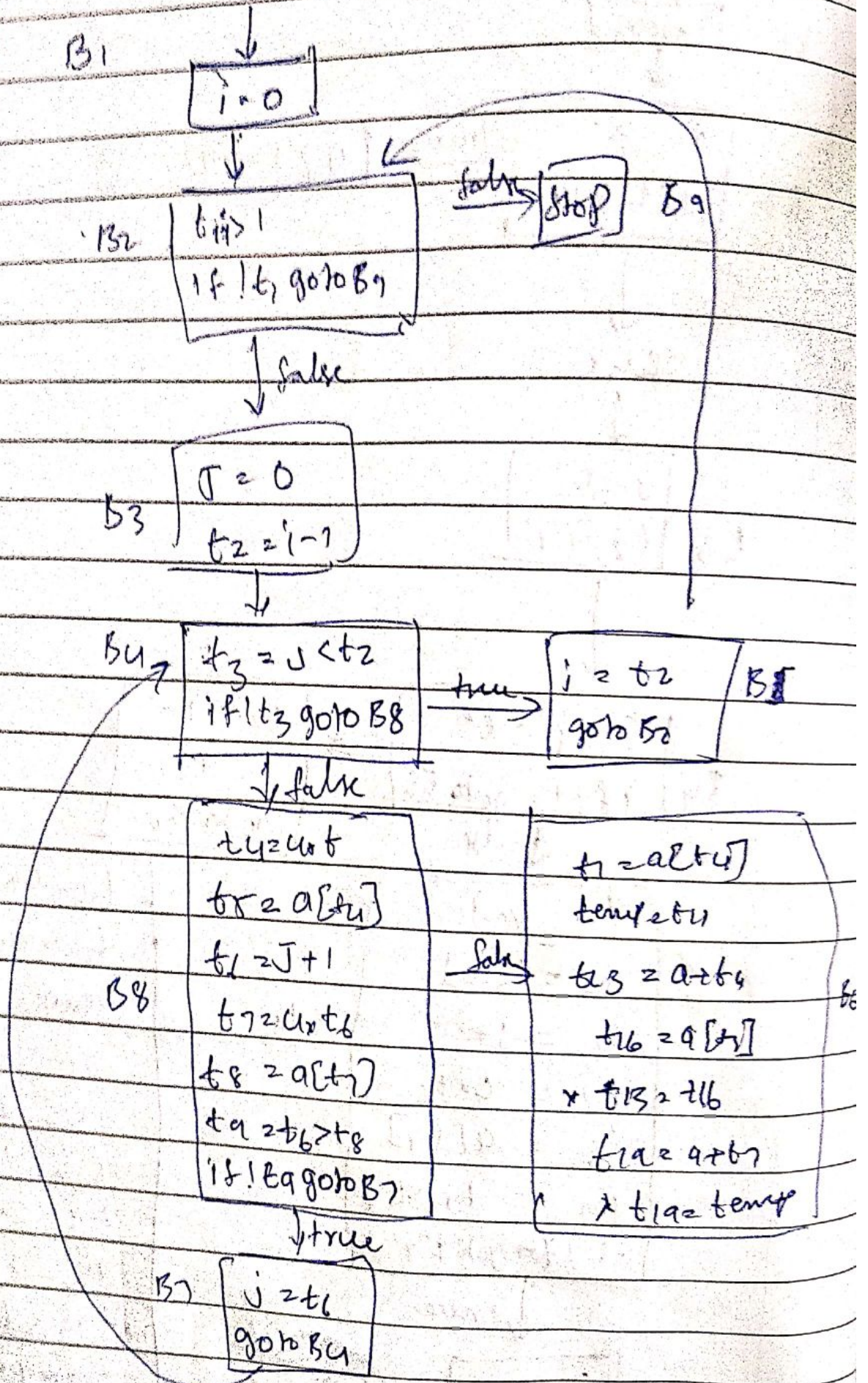
B₆

t₁₀ = t₄
t₁₁ = a[t₁₀]
t₁₂ = t₄
t₁₃ = a[t₁₂]
t₁₄ = t₆
t₁₅ = t₄ * t₁₄
t₁₆ = a[t₁₅]
t₁₇ = t₁₆
t₁₈ = a[t₁₇]
t₁₉ = a[t₁₈]
t₁₉ = temp

B₇

t₂₀ = t₆
j = t₂₀
goto B₄

BCS and Copy Propagation



IV detection and CSE triples for I.V
(Induction variables).

$j = (j, i, 0)$

$t_u = (j, u, 0)$

$t_6 = (j, 1, 1)$

$t_7 = (j, u, u)$

B1

$i = 0$

B2

$t_1 > 1$

if !t, goto B4

true

B4

stop

false

B3

$j = 0$

$s_u = u + 9$

$s_6 = j + 1$

$s_7 = u + j$

$s_7 = s_7 + u$

B4

$t_3 = i < t_2$

if !t3 goto B8

true

$i = t_2$

goto B2

B8

false

$j = s_6$

$s_u = s_7 + u$

$s_1 = s_6 + 1$

$s_7 = s_7 + u$

~~$s_7 = s_7 + u$~~
goto B4

true

$t_u = s_4$

$t_3 = a[t_u]$

$t_1 = s_1$

$t_7 = s_7$

$t_8 = a[t_7]$

$t_9 = t_7 > t_8$

if !t9 goto B7

stop

false

$t_{11} = a[t_4]$

temp = t_{11}

$t_{15} = a + t_4$

$t_{16} = a[t_7]$

$t_{13} = t_{16}$

$t_{19} = a + s_7$

$t_{19} = temp$