Pg-1

Tutorial-6

RAHUL AM-EN 04 CSE/17335

```
i = m-1
j = n
t1 = 4*n
p = a[t1]
```

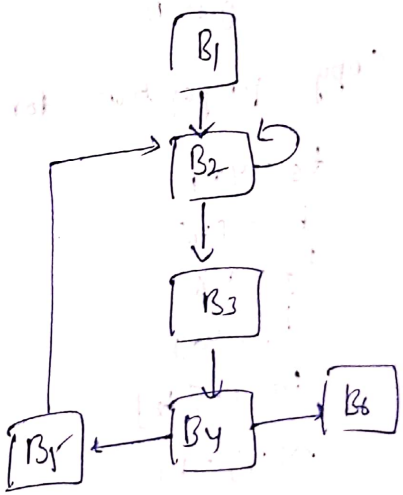
```
i = i+1
t2 = 4*i
t3 = a[t2]
if t3<p goto B2
```

```
j = j-1
t4 = 4*j
t5 = a[t4]
if t5>p goto B2
```

```
if i>=j goto B6
```

```
t6 = 4*i
t7 = a[t6]
t8 = 4*i
t9 = 4*j
t10 = a[t9]
a[t8] = t10
goto B2
```

```
t11 = 4*i
t = a[t11]
t12 = 4*i
t13 = 4*n
t14 = a[t13]
a[t12] = t14
t15 = 4*n
a[t15] = t
```



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Pg 2

local common subexpression elimination

B5 B6

B5

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

B6

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

Copy propogation for $t_7, t_{10}, t_{12}, t_{15}$.

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

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

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Dead code elimination for t_7 t_{10} t_{12} t_{15}

$t_6 = 4 * i$

$t_7 = a[t_6]$

$t_8 = 4 * j$

$t_9 = a[t_8]$

$a[t_6] = t_9$

$a[t_8] = t$

goto B_2

$t_{11} = 4 * i$

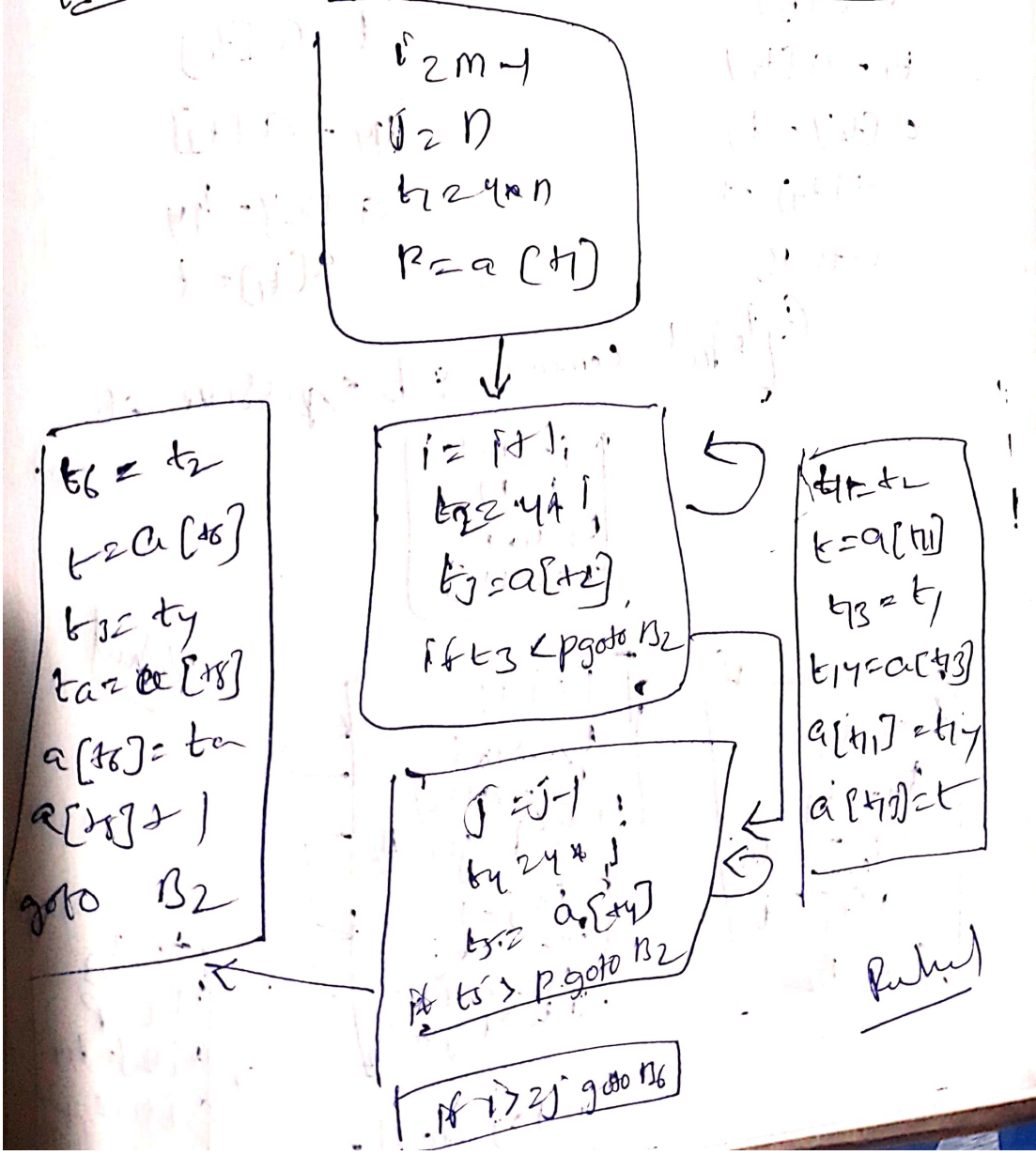
$t = a[t_{11}]$

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

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

$a[t_{13}] = t$

Global Common subexpression elimination



$i = m - 1$

$j = n$

$t_1 = 4 * n$

$p = a[t_1]$

$i = i + 1$

$t_2 = 4 * i$

$t_3 = a[t_2]$

if $t_3 < p$ goto B_2

$t_6 = t_2$

$t = a[t_6]$

$t_3 = t_4$

$t_9 = a[t_8]$

$a[t_6] = t_9$

$a[t_8] = t$

goto B_2

$t_{11} = t_2$

$t = a[t_{11}]$

$t_{13} = t_1$

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

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

$a[t_{13}] = t$

$j = j - 1$

$t_4 = 4 * j$

$t_5 = a[t_4]$

if $t_5 > p$ goto B_2

if $i > 2j$ goto B_6

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

$t_6 = t_2$
$t = a[t_2]$
$t_8 = t_4$
$t_a = a(t_4)$
$a[t_2] = t_9$
$a[t_4] = t$
goto B_2

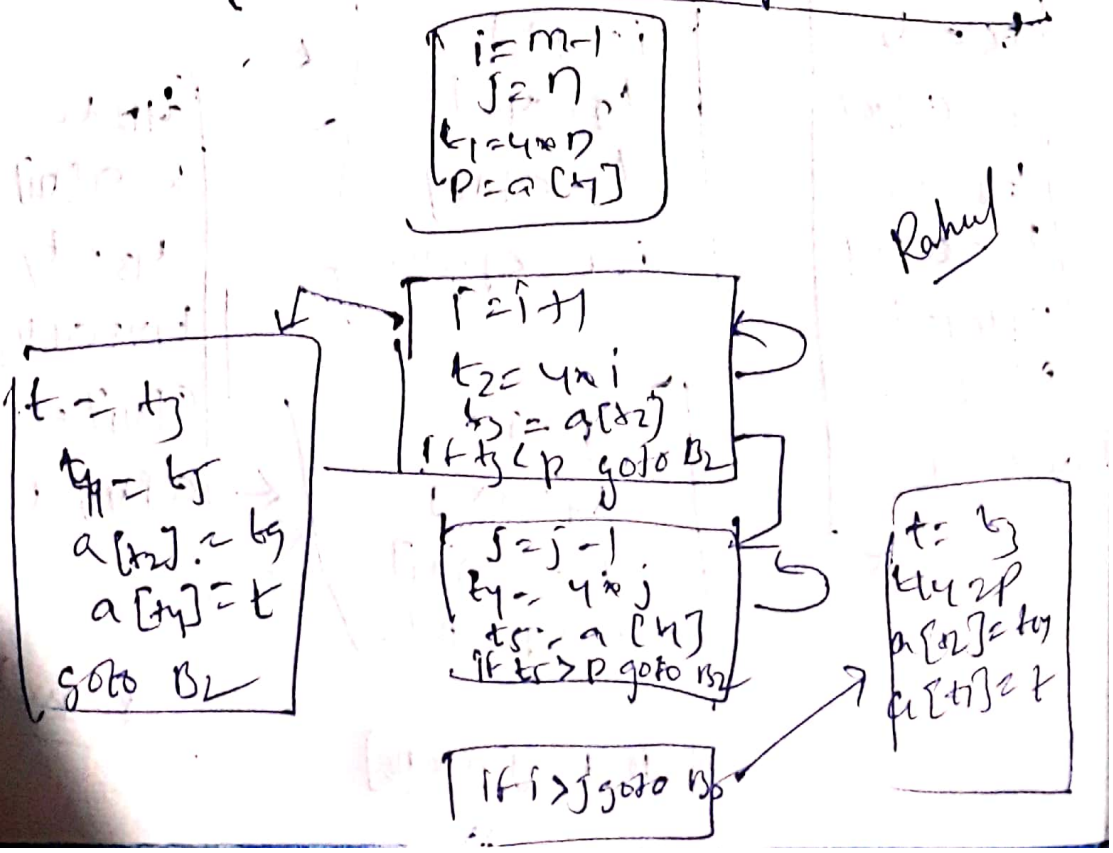
$t_1 = t_2$
$t = a[t_2]$
$t_3 = d_1$
$t_{14} = a[t_1]$
$a[t_2] = t_{14}$
$a[t_1] = t$

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

B_5
$t = a(t_2)$
$t_9 = a[t_4]$
$a[t_2] = t_9$
$a[t_4] = t$
goto B_2

B_6
$t = a[t_2]$
$t_{14} = a[t_1]$
$a[t_2] = t_{14}$
$a[t_1] = t$

Global common sub expression elim



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Copy propagation on t_2, t_4, t_5

B5

$t_2 = t_5$

$t_4 = t_5$

$a[t_2] = t_5$

$a[t_4] = t_5$

goto B_2

B6

$t_2 t_5$

$t_4 2 p$

$a[t_2] = p$

$a[t_6] = t_5$

Dead code elimination on t, t_4, t_5

B5

$a(t_2) = t_5$

$a[t_4] = t_5$

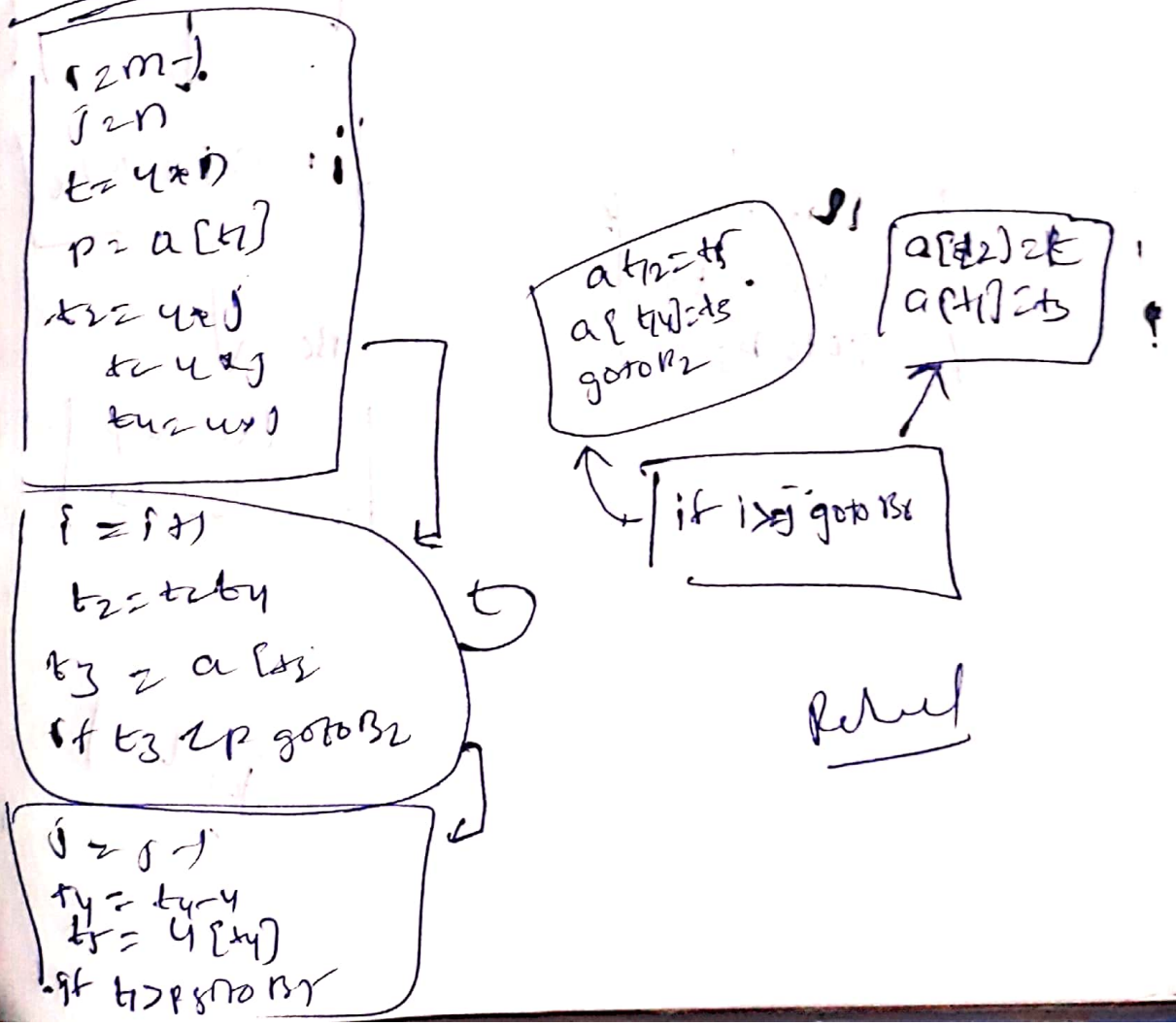
goto B_2

B6

$a[t_2] = p$

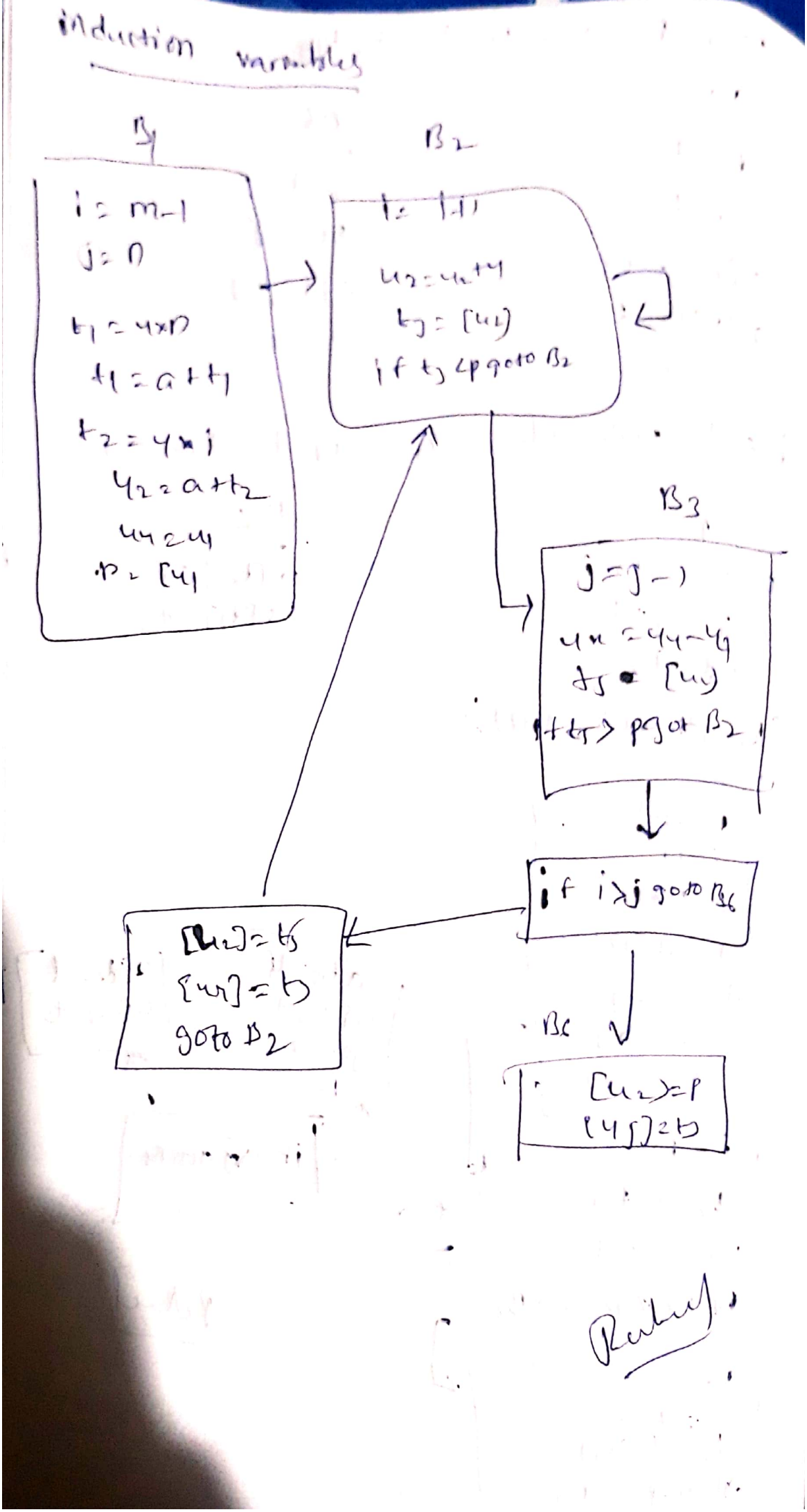
$a[t_4] = t_5$

Strength reduction :-



Result

Induction variables

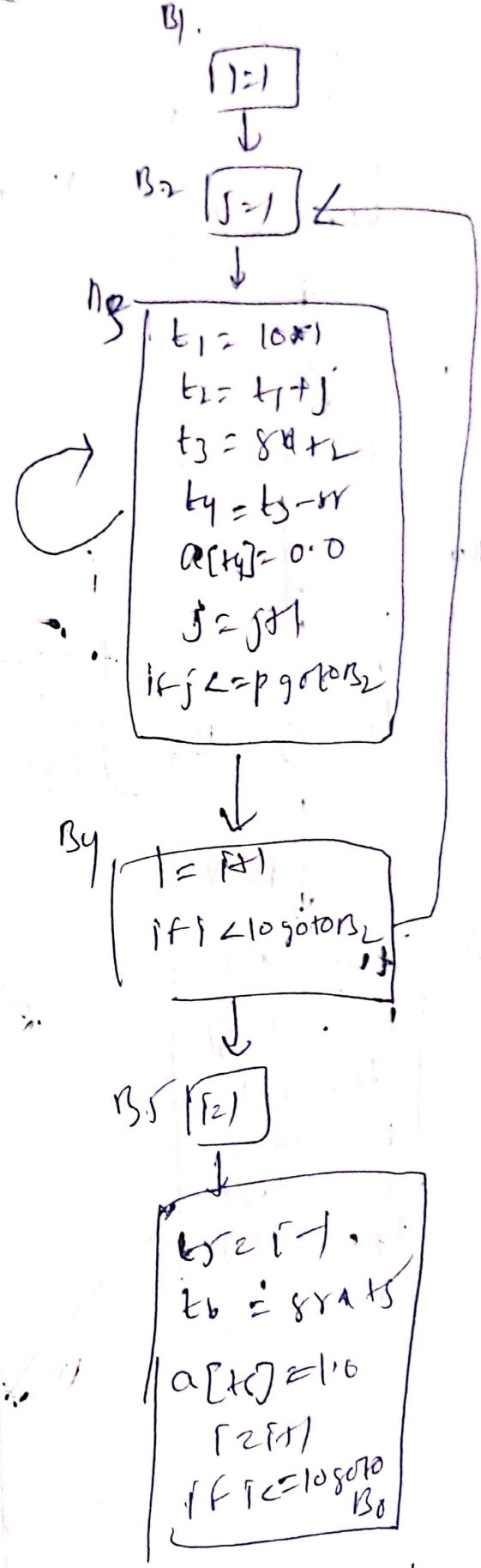


Result

Question 2

Code 2

1) i = 1
2) j = 1
3) t1 = 10 * j
4) t2 = t1 + j
5) t3 = 8 * t2
6) t4 = t3 - 8
7) j = j + 1
9) i + j <= 10 goto (3)
10) i = i + 1
11) i + i < 10 goto (2)
12) i = 1
13) t5 = i - 1
14) t6 = 8 * t5
15) a[t6] = 1.0
16) i = i + 1
17) if i <= 10 goto 13



No GCSE
No copy propogation
No loop invariants
induction variables.

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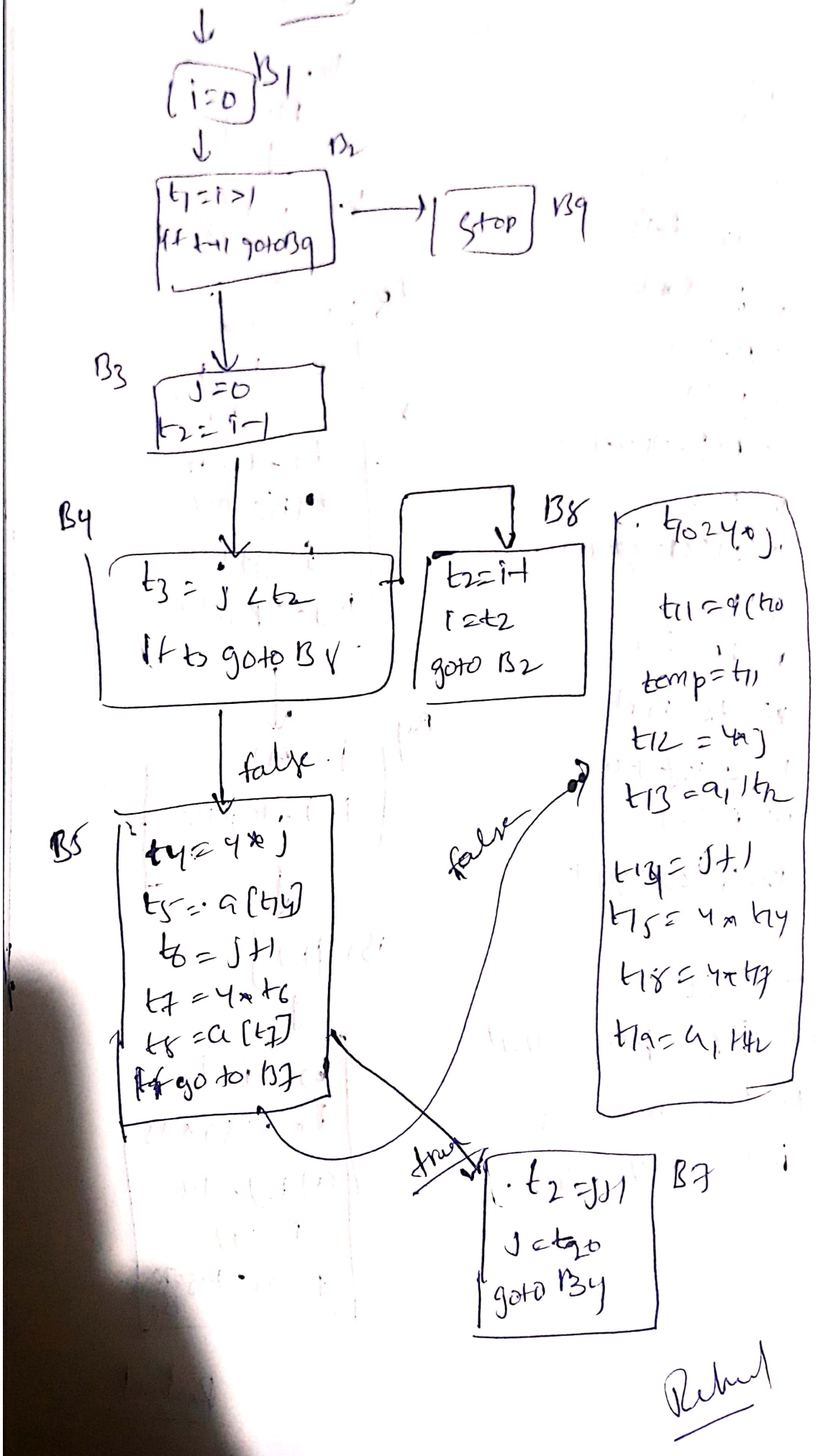
Code 3



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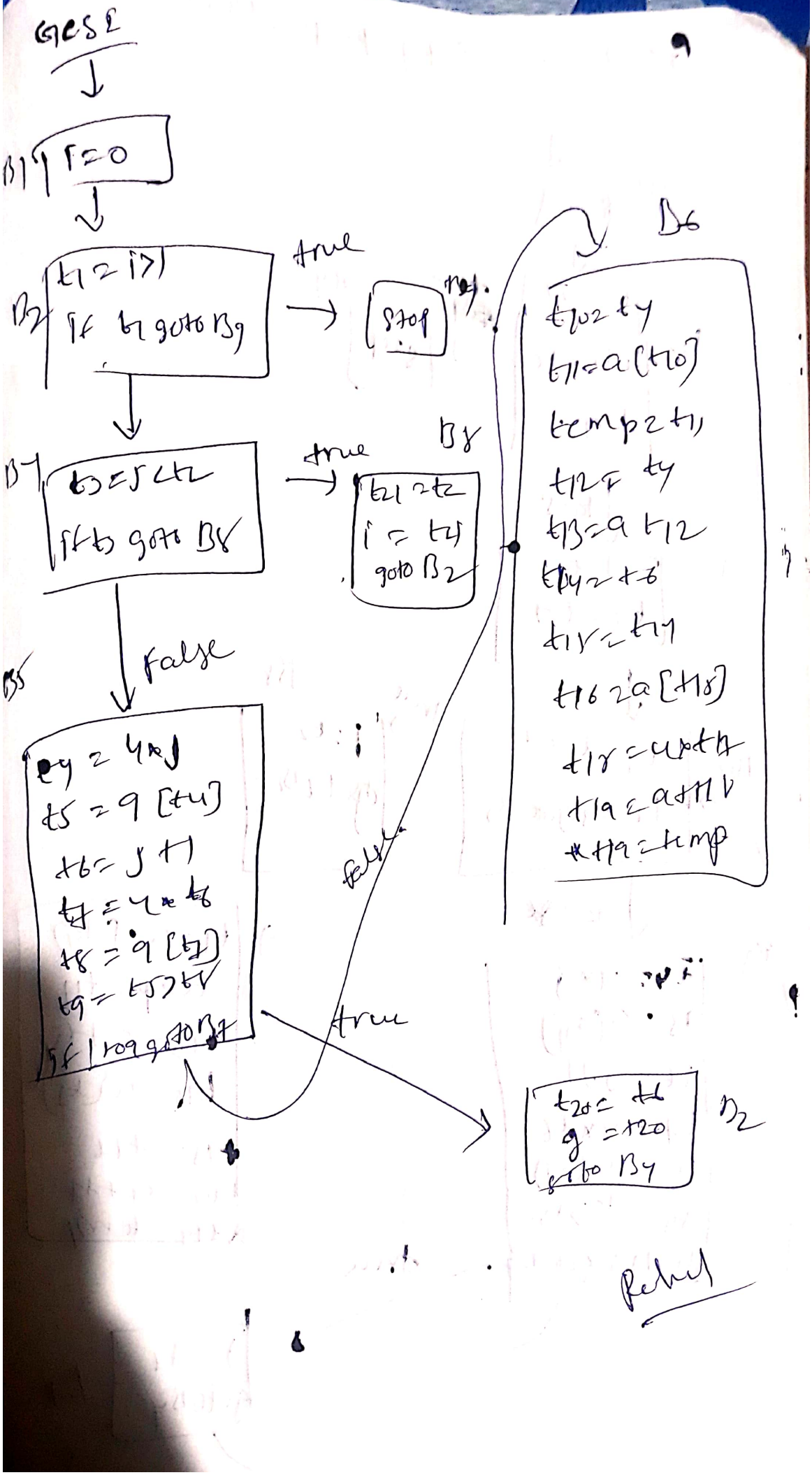

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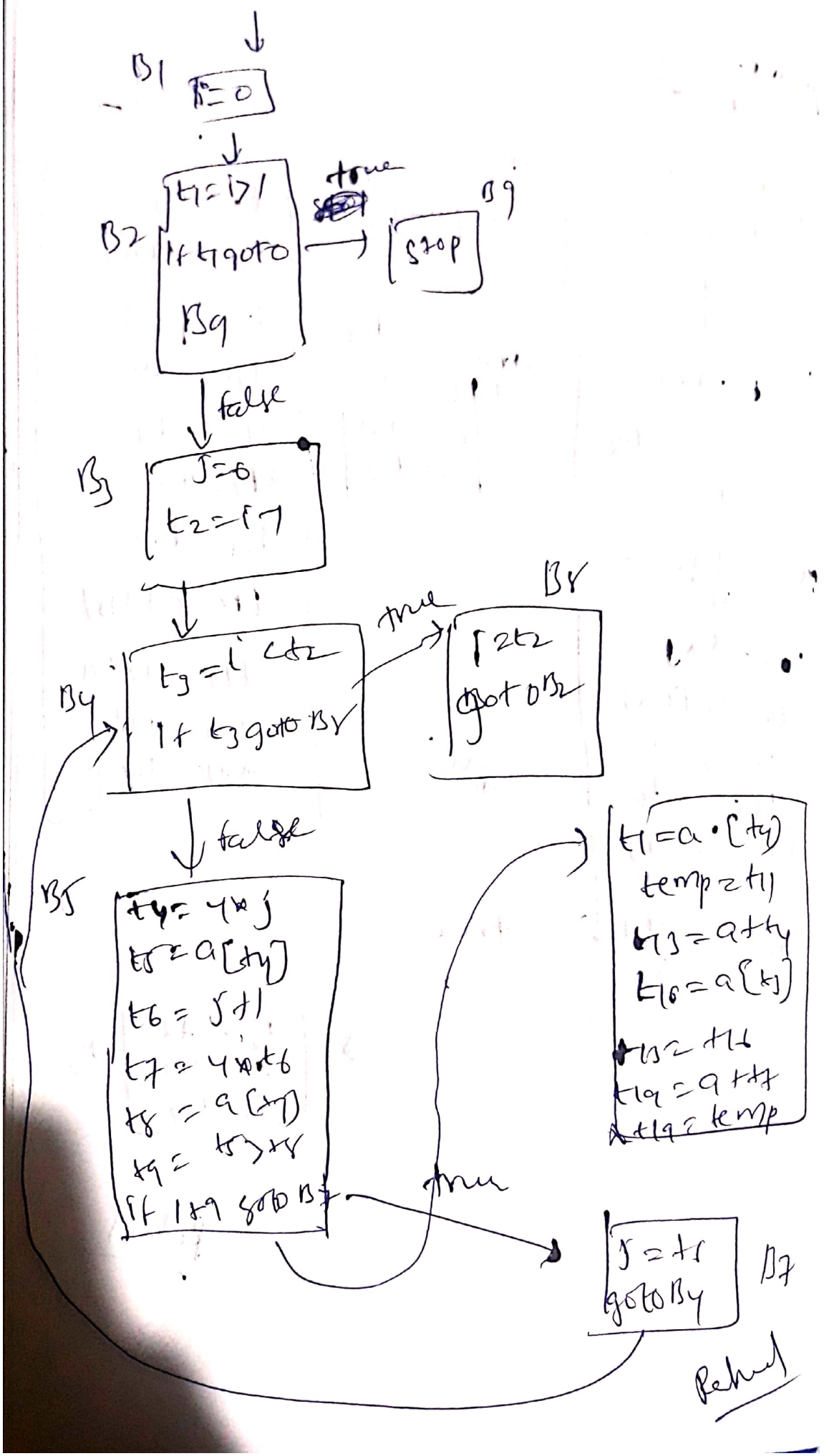
CSE and copy propagation



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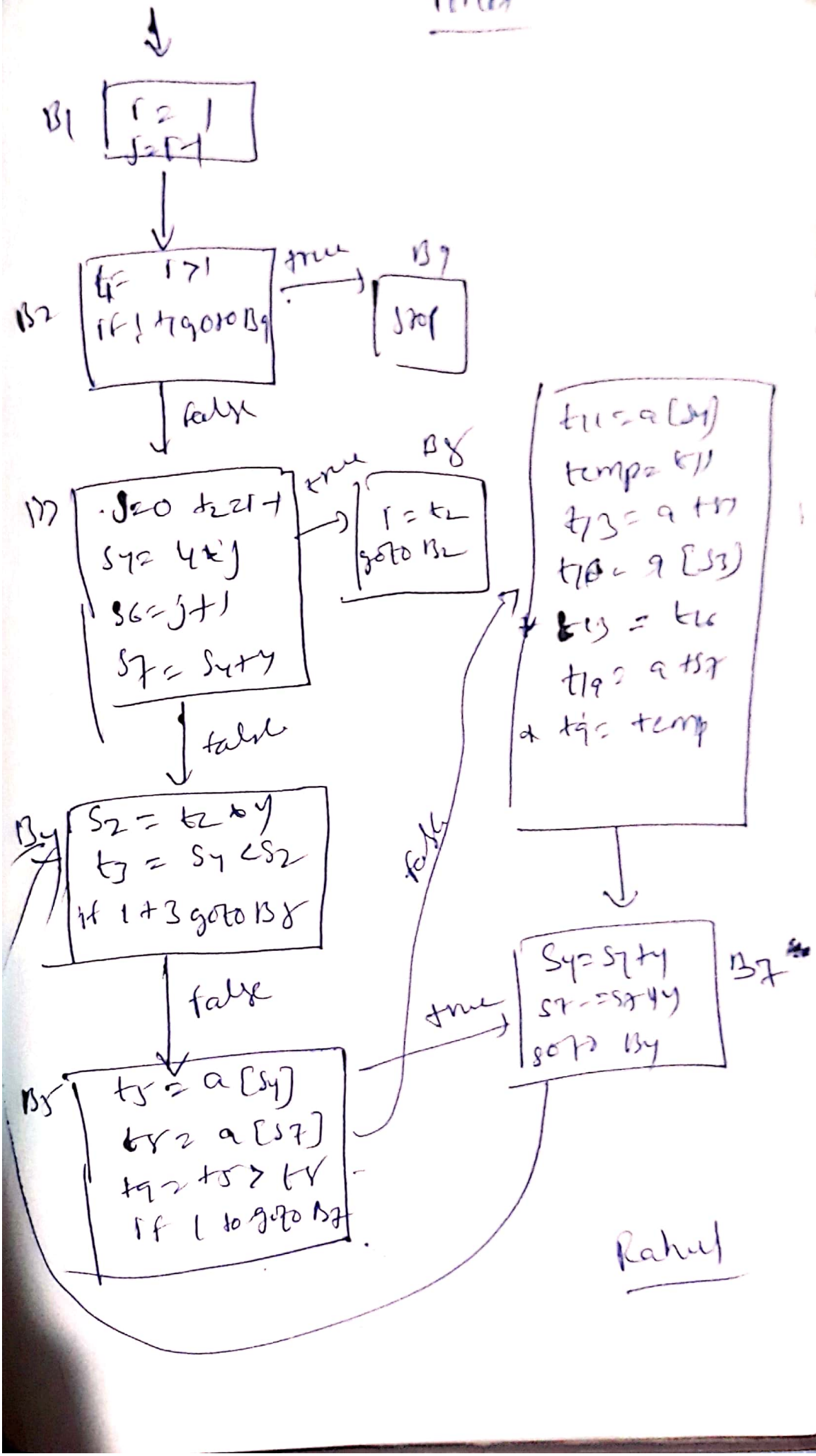
final



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