15+10

CSE340 - Assignment 03

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Q1. add: 20%, addi: 20%, not: 0%, beq: 25%, lw: 25%, sw: 10%.

Data Memory is used in lw & sw instructions only.

Total Cycle Time = 20 + 20 + 0 + 25 + 25 + 10 = 100%

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Fraction (of data cycles in data memory) = $\frac{25+10}{100} = \frac{35}{100} = \left(\frac{7}{20}\right) \times \frac{1}{5}$

$= \frac{7}{100}$

Q2. Sign-Extender Circuit is needed for every I-Type instructions.

Therefore, addi, beq, lw & sw.

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Total Cycle Time = 20 + 20 + 0 + 25 + 25 + 10 = 100%

Fraction (of data cycles in sign-extender) = $\frac{20+25+25+10}{100} = \left(\frac{4}{5}\right) \times \frac{1}{5}$

$= \frac{4}{25}$

Q3.

```
lw  $t0, 36($t1)
lw  $t2, 40($t0)
lw  $t3, 44($t2)
sll $t3, $t2, 2
sub $t0, $t3, $t2
addi $t0, $t0, 2
srl $t0, $t3, 2
```

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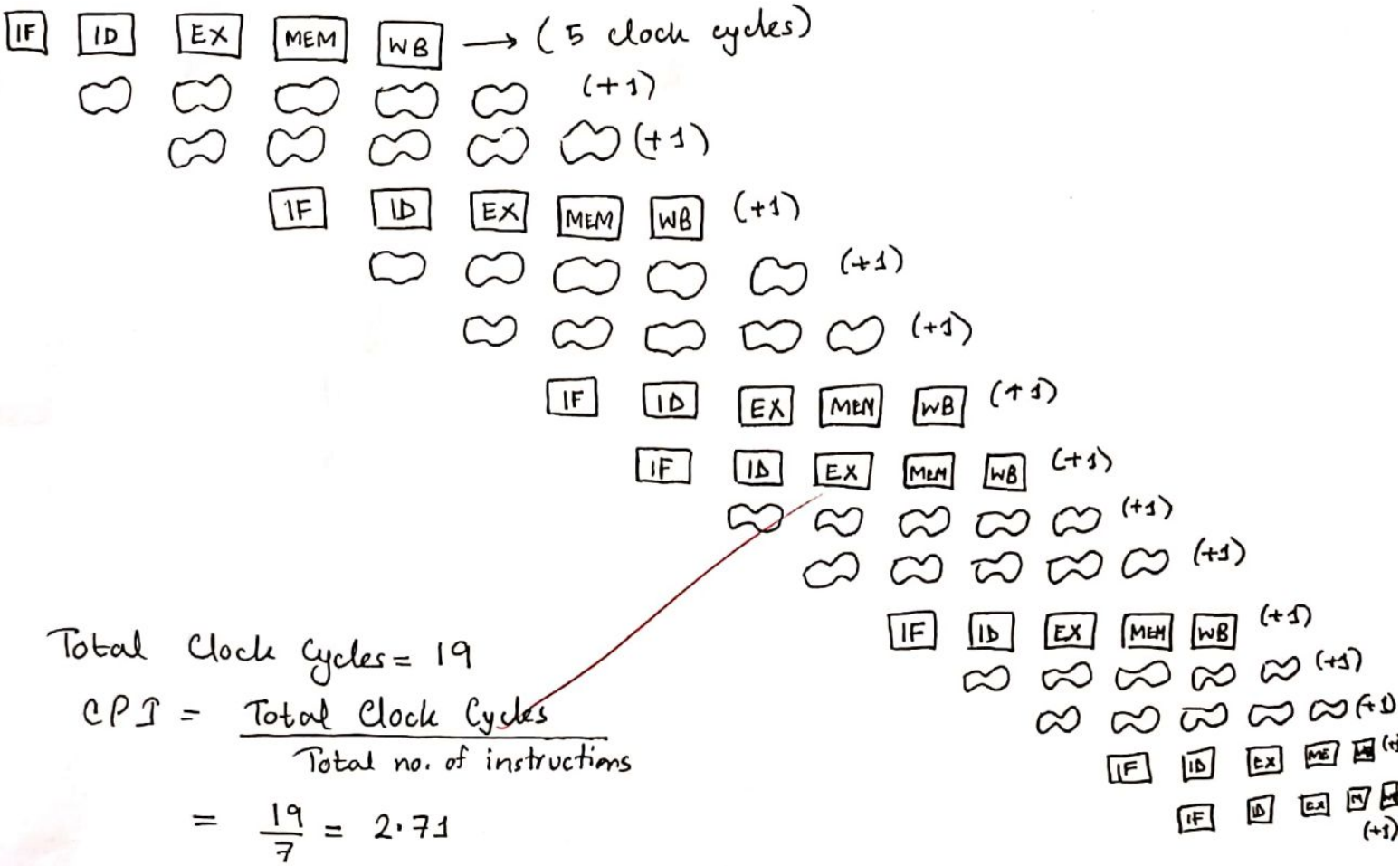
Using Only Stalling,

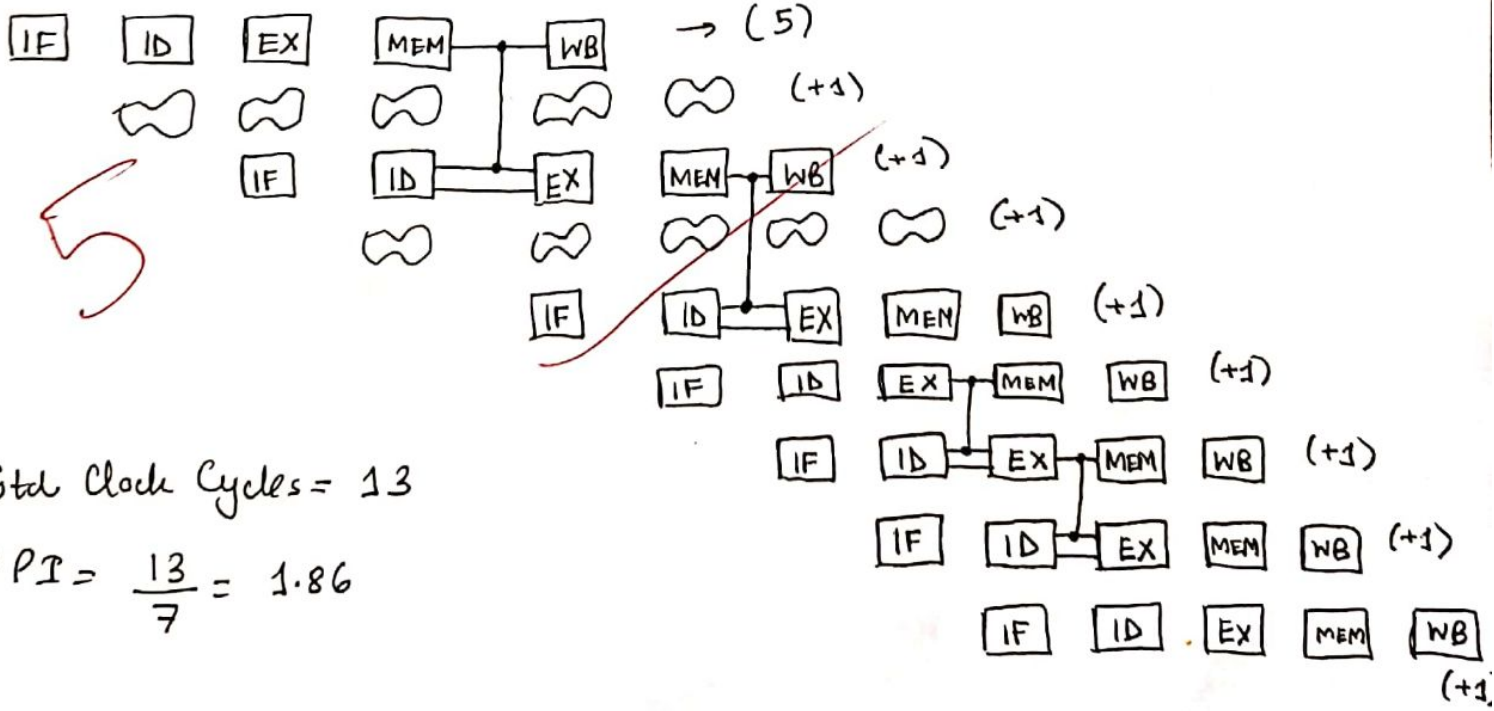


Total Clock Cycles = 19

$$CPI = \frac{\text{Total Clock Cycles}}{\text{Total no. of instructions}}$$

$$= \frac{19}{7} = 2.71$$

Q4. Using Stalling + Forwarding.



Total Clock Cycles = 13

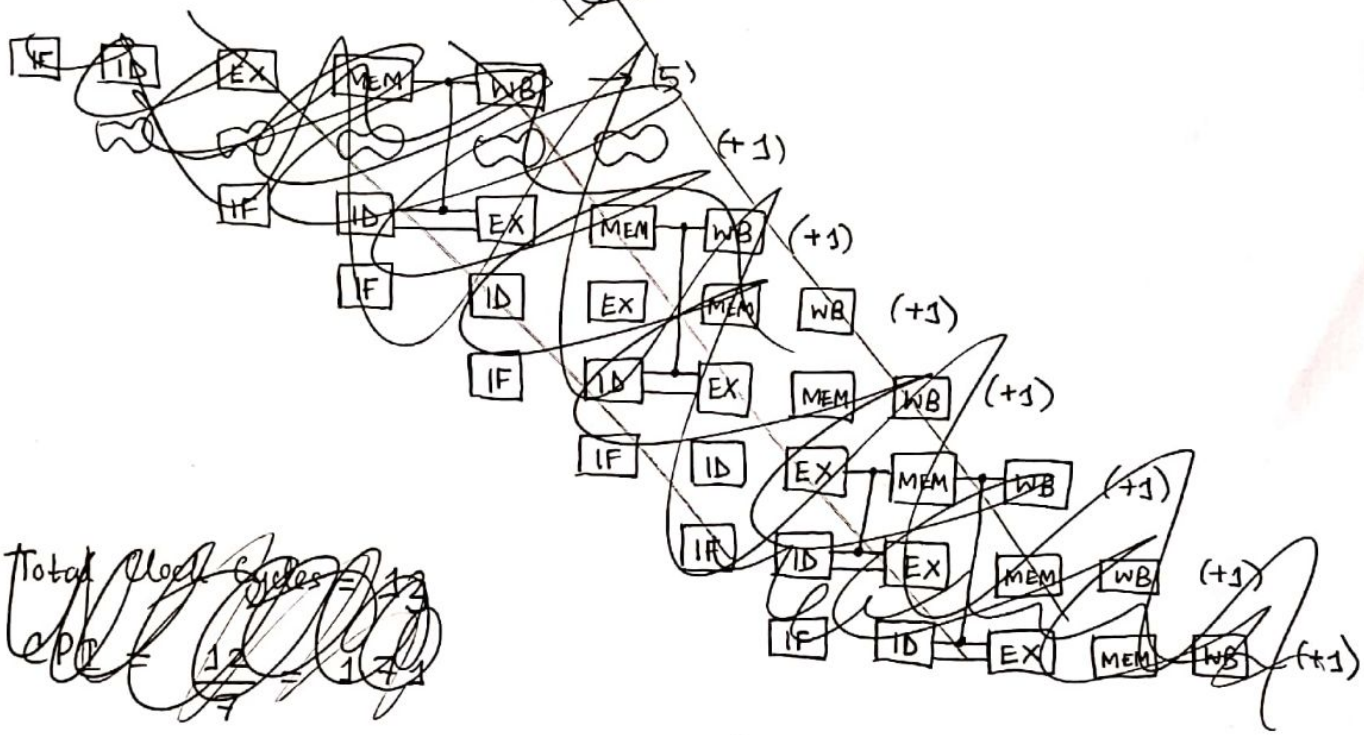
$$CPI = \frac{13}{7} = 1.86$$

Q5 Using Stalling + Forward + Code Scheduling,

After ~~Rearranging~~ the code,

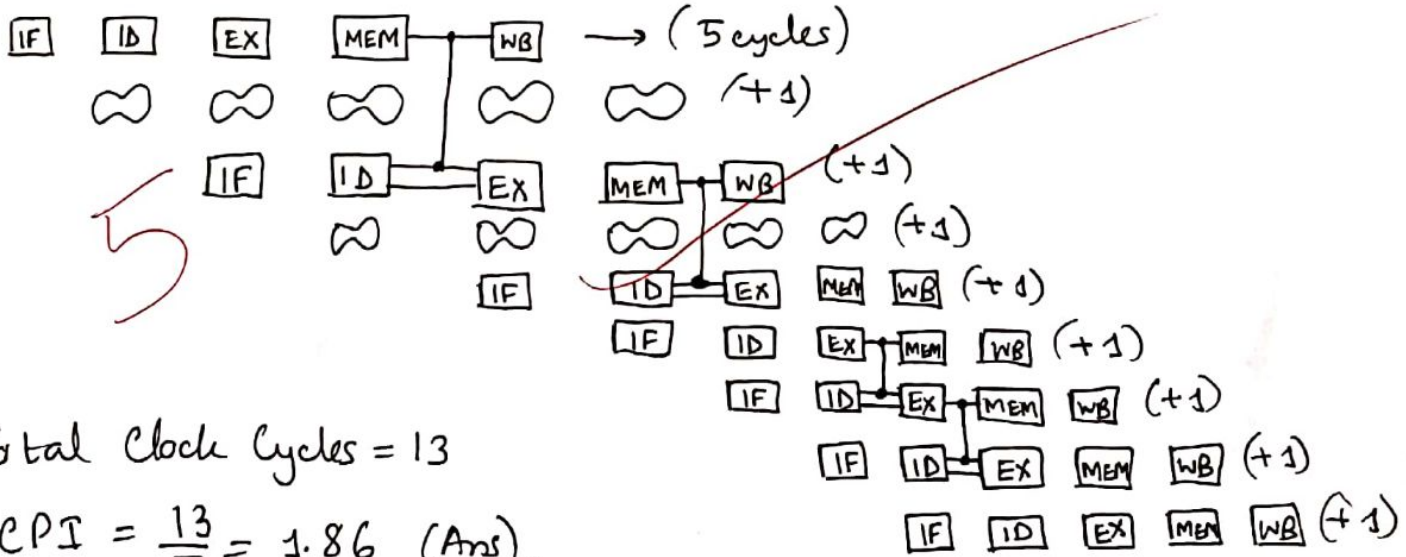
```
lw   $t0, 36($t1)
lw   $t2, 40($t0)
addi $t0, $t0, 2
lw   $t3, 44($t2)
sll  $t3, $t2, 2
sub  $t0, $t3, $t2
srl  $t0, $t3, 2
```

No scheduling possible here!



~~Total Clock Cycles = 13~~

~~CPI = 13/7 = 1.71~~



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Total Clock Cycles = 13

CPI = $\frac{13}{7}$ = 1.86 (Ans).