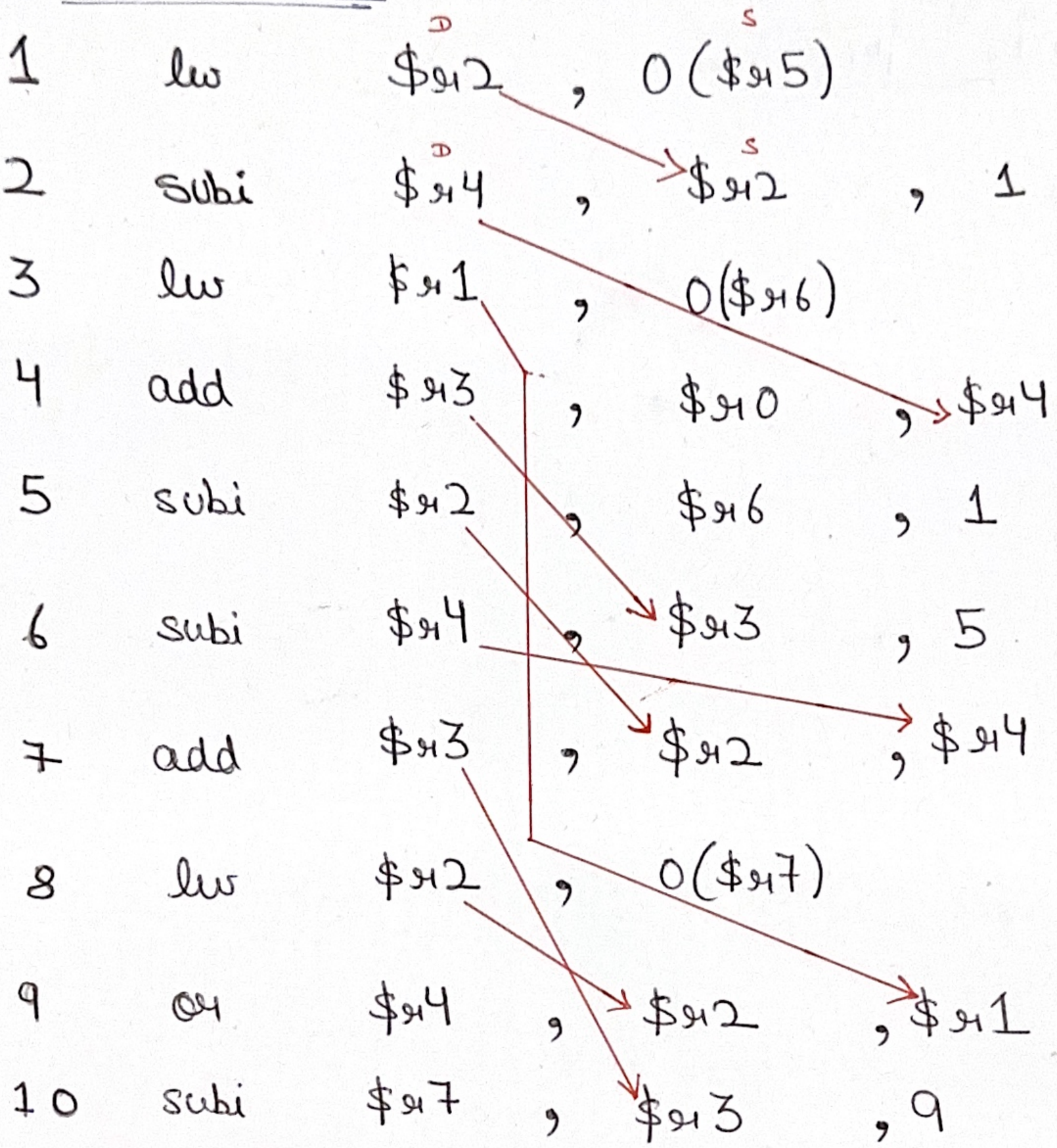
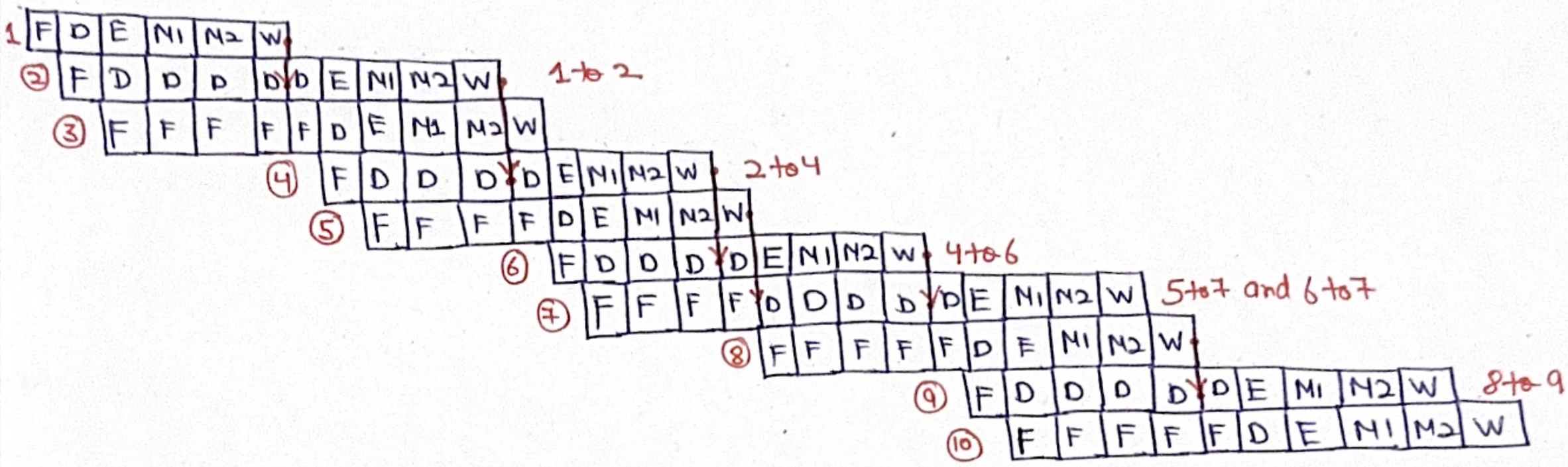
ASSIGNMENT 2 - DIVYANK SHARMA

Checking Dependencies :-



Architecture 2 - Only stalling, No forwarding pipelines ≒



$$CPI = \frac{\text{No of cycles}}{\text{Total Instructions}} = \frac{33}{10} = 3.3$$

① From 1 to 2

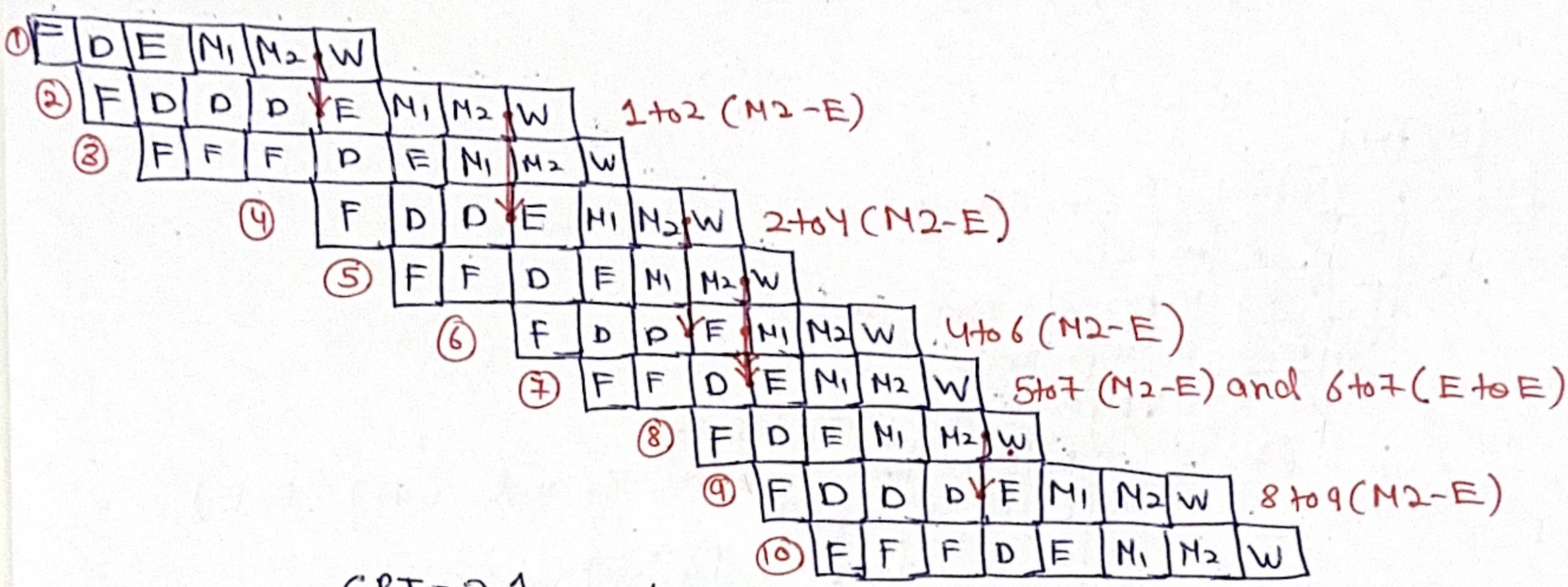
② From 2 to 4

③ From 4 to 6

④ From 5 to 7 and 6 to 7

⑤ From 8 to 9

Ans. M2-E, E-E, W-D, ALU can fetch at E, M2, W
Lw/Sw can fetch at M2, W



$$CPI = \frac{21}{10} = \underline{2.1}$$

Steps :-

1.] For 2nd instruction it has dependency on 1st. and 1st is (l w).
So the output will be ready to read after M2. So we used M2-E.

2.] For 4th, depends on 2nd and 2nd is an ALU instruction, ready to be read after E, M1, M2, W but can only use E-E, M2-E, W-D. So we used M2-E.

3.] 6th, depends on 4th (an ALU instruction) can be read at E, M2, W as per rules of this architecture. So we can't use E to E so we used M2-E.

4.] 7th, depends on 5th and 6th, both are ALU can be read at E, M2, W.
But we need to read them at same cycle. For 6th, E to E and 5th, M2-E.

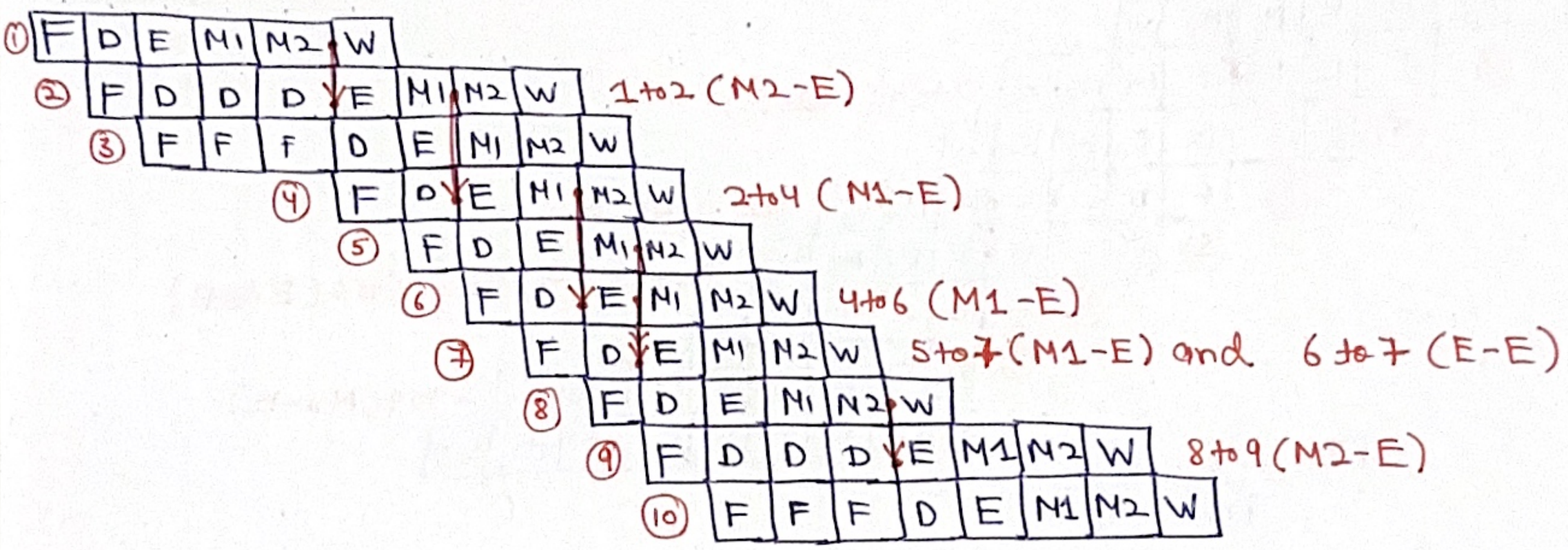
5.] 9th, depends on 8th and 3rd. But 3rd already finished so no dependency
For 8th its lw so we can read at M2 or W. So M2-E.

6.] 10th, depends on 7th (ALU). We can fetch at W but as we can see W is finished and then D starts so the values will be ready to be read already by 10th instruction. (W-D)

Architecture 4

ALU can fetch at E, M1, M2, W
LW/SW can fetch at M2, W

E→E, M1→E, M2→E, W→D



$$CPI = \frac{19}{10} = 1.9$$

Steps →

1.] For 2nd it depends on 1st ie.. lw so we can read at M2 or W.
Here we used M2-E.

2.] For 4th, depends on 2nd (ALU) we can read at M1, M2, E, W. So latest is M1-E.

3.] For 6th, depends on 4th (ALU) we can read at M1-E.

4.] For 7th, depends on 5th and 6th both ALU. We can read at E, M1, M2, W
from 5th we can read at M1-E and for 6th E-E.

5th] For 9th, depends on 8th and 3rd. as 3rd already finished so only on 8th (lw). So for lw the instructions can be read at M2, W.
So we read at M2-E.

6th] For 10th, depends on 7th (ALU) as 7th ends and D starts for 10th so the values can be fetched as they will be ready before D. (W-D)