Abdelrahman Adel Abdelfattah Sheet 3 1701296 NOTES

(1) a) ii) Data

b) ii) Data

c) i) Structural

(2) a) i) RAW

b) ii) WAR

c) iv) None

(3) a) Note that scoreboard follows in-order issuing for instructions.
- So I3 can be issued as there are no WAW dependance nor structural hazard.
- I4 cannot be issued because it has WAW dependence with I2
- I5 cannot be issued as I4 cannot be issued

b)

| Instruction status | ISSUED | Operands read | Execution Completed | Result Written |
|---|---|---|---|---|
| I1 | Yes | Yes | | |
| I2 | Yes | | | |
| I3 | Yes | | | |
| I4 | No | | | |
| I5 | No | | | |

. Functional Unit status

NOTES.

| | Busy | Op. | Dest | Source 1 | Source 2 | Unit 1 | Unit 2 | Rdy1 | Rdy2 |
|---|---|---|---|---|---|---|---|---|---|
| FU1 | Yes | ADDI | R5 | R5 | | | | No | |
| FU2 | Yes | LF | F3 | R5 | | FU1 | | No | |
| FU3 | Yes | ADDF | F4 | F3 | F0 | | | Yes | Yes |
| FU4 | No | | | | | | | | |
| FU5 | No | | | | | | | | |

Register status

| Reg. | F0 | F1 | F2 | F3 | F4 | F5 | R5 |
|---|---|---|---|---|---|---|---|
| FU | | | | FU2 | FU3 | | FU1 |

#

④ Nam dependance:

When two instruction use the same register or memory location, called a name but there is no flow of data between instructions associated with that name

2 Types

1- anti dependence: when j writes to name i Reads

ADD R1, R3, R4

LD R4, 0(R0) → use a different name R5

2- output dependance: when i and j write to the same name

ADD R4, R3, R1

LD R4, 0(R0) → R5

(5) Assumptions

1. S → F2
2. highest address → R1
3. lowest address -8 → R2

LOOP:

```
L.D      F0, 0(R1)
ADD.D    F4, F0, F2
S.D      F4, 0(R1)
DADDUI   R1, R1, #-8
BNE      R1, R2, Loop
```

(6) Scheduled:

LOOP:

```
LD       F0, 0(R1)
ADDUI    R1, R1, #-8
ADD.D    F4, F0, F2
stall
stall
S.D      F4, 8(R1)
BNE      R1, R2, LOOP
```

⑥ unrolled loop:

NOTES.

```
LOOP: L.D     F0, 0(R1)
      ADD.D   F4, F0, F2
      S.D     F4, 0(R1)        ; drop DADDUI & BNE
      L.D     F6, -8(R1)
      ADD.D   F8, F6, F2
      S.D     F8, -8(R1)       ; " " "
      L.D     F10, -16(R1)
      ADD.D   F12, F10, F2
      S.D     F12, -16(R1)     ; " " "
      L.D     F14, -24(R1)
      ADD.D   F16, F14, F2
      S.D     F16, -24(R1)
      DADDUI  R1, R1, #-32
      BNE     R1, R2, LOOP
```

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⑦

```
LOOP: L.D     F0, 0(R1)
      L.D     F6, -8(R1)
      L.D     F10, -16(R1)
      L.D     F14, -24(R1)
      ADD.D   F4, F0, F2
      ADD.D   F8, F6, F2
      ADD.D   F12, F10, F2
      ADD.D   F16, F14, F2
      S.D     F4, 0(R1)
      S.D     F8, -8(R1)
      DADDUI  R1, R1, #-32
      S.D     F12, 16(R1)
      S.D     F16, 8(R1)
      BNE     R1, R2, LOOP
```

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