Assignment 2

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Solve A2.1 and A2.2 given in the Course information

Solve the below problems:

- **Consider the following sequence of instructions in MIPS architecture.**

LDR R1, [R2,#40]
ADD R2, R3, R3
ADD R1, R1, R2
STR R1, [R2,#20]
a. Find all dependencies in this instruction sequence.
b. Find all hazards in this instruction sequence for a five stage pipeline with and without data forwarding.
c. Find whether NOPs are required to be introduced inspite of data forwarding in this instruction sequence

- **.Consider the following sequence of instructions in MIPS architecture.**

```
        LDR  R1, [R6,#40]
        BEQ  R2, R3, LABEL2   ; BRANCH TAKEN
        ADD R1, R6, R4
LABEL2:BEQ R1,R2, LABEL1      ; BRANCH NOT TAKEN
        STR R2,[R4, #20]
        AND R1, R1, R4
```

a. Draw the pipeline execution diagram for this code, assuming there are no delay slots and that branches execute in the EX stage.b. Repeat the exercise mentioned in a and draw the pipeline execution diagram for this code, assuming that delay slots are used by writing a "SAFE INSTRUCTION" in the delay slot.

DATE

Assignment A2.1 :

```
LDR R1, [R2, #40]
ADD R2, R3, R3
ADD R1, R1, R2
STR R1, [R2, #20]
```

a. Find all dependencies

- WAR → between instruction 1 and 2.
- RAW → between instruction 1 and 3
  between instruction 2 and 3.
  between instruction 3 and 4.
- WAW → between instruction 1 and 3.

b. Find all hazards with and without data forwarding

Without data forwarding: (RAW) data hazards

```
IF ID EX M W |R1
   IF ID EX M W |R2
      IF * * * ID EX M W |R1
               IF * * * ID EX M W
```

With data forwarding: Raw dependencies are removed

```
IF ID EX M |R1 W
   IF ID EX |R2 M W
      IF ID EX |R1 M W
         IF ID EX M W
```

c. Find whether NOPs are required to be introduced inspite of data forwarding in this instruction sequence. – No NOPs are needed

A2.2:

```
        LDR R1, [R6, #40]
        BEQ R2, R3, LABEL2;  Branch Taken
        ADD R1, R6, R4
LABEL2: BEQ R1, R2, LABEL1;  Branch not taken
        STR R2, [R4, #10]
        AND R1, R1, R4
```

a)
```
IF ID EX M W
   IF ID EX ME W
      IF ID EX M W
         IF ID EX M W
            IF ID EX M W
```

b)
```
IF ID EX M W
   IF ID EX ME W
      *  *  *  *  *
         *  *  *  *  *
            IF ID EX M W
               *  *  *  *  *
                  *  *  *  *  *
                     IF ID EX M W
                        IF ID EX M W
```