

## *Assignment-2: Pipelining*

*Arnab Das, u1014840*

*February 25, 2018*

# 1 Question 1

## i. optimized schedule without unrolling

```

Loop :   L.D   F1, o(R1)
         L.D   F2, o(R2)
         DADDUI R1, R1, #-8
         MUL   F3, F1, F2
         DADDUI R2, R2, #-8
         DADDUI R3, R3, #-8
         STALL
         BNE   R1, R4, Loop
         S.D   F3, 8(R3)

```

## ii. With unrolling

```

Loop :   L.D   F1, o(R1)
         L.D   F2, o(R2)
         L.D   F11, -8(R1)
         MUL   F3, F1, F2
         L.D   F22, -8(R2)
         DADDUI R1, R1, #-16
         MUL   F33, F11, F22
         DADDUI R2, R2, #-16
         S.D   F3, o(R3)
         DADDUI R3, R3, #-16
         BNE   R1, R4, Loop
         S.D   F33, 8(R3)

```

*iii. Software pipelined*

```

Loop :   S.D  F3, 16(R3)
          MUL  F3, F1, F2
          L.D  F1, 0(R2)
          L.D  F2, 0(R1)
          DADDUI R1, R1, #-8
          DADDUI R2, R2, #-8
          BNE  R1, R4, Loop
          DADDUI R3, R3, #-8

```

**2 Question 2***Optimized without unrolling*

```

Loop :   L.D  F2, 0(R2)
          L.D  F3, 0(R3)
          L.D  F4, 0(R4)
          MUL  F1, F2, F3
          ADD  F5, F4, F1
          DADDUI R2, R2, #-8
          DADDUI R3, R3, #-8
          DADDUI R4, R4, #-8
          DADDUI R5, R5, #-8
          BNE  R2, R1, Loop
          S.D  F5, 8(R5)

```

### 3 Question 3

#### i. Optimized without unrolling

```

Loop :      L.D  F1, 0(R1)
            DADDUI R1, R1, #-8
            DADDUI R2, R2, #-8      F.MUL  F3, F1, F2
                                     Stall
                                     Stall
            F.ADD  F5, F3, F4
            Stall
            Stall
            Stall
            Stall
            BNE  R1, R3, Loop
            S.D  F5, 8(R2)
    
```

#### ii. Optimized with loop unrolling

```

Loop :      L.D  F1, 0(R1)
            L.D  F11, -8(R1)
            L.D  F12, -16(R1)      F.MUL  F3, F1, F2
                                     F.MUL  F31, F11, F2
            Stall                  F.ADD  F5, F3, F4
            Stall                  F.MUL  F32, F12, F2
            Stall                  F.ADD  F51, F31, F4
            Stall                  F.ADD  F52, F32, F4
            Stall
            DADDUI R1, R1, #-24
            S.D  F5, 0(R2)
            DADDUI R2, R2, #-24
            S.D  F51, 16(R2)
            BNE  R1, R3, Loop
            S.D  F52, 8(R2)
    
```