Solutions for Homework 7

CIS 501, Spring 1998
April 8, 1998

1. Unroll the following two loops as many times as necessary to schedule them without delays, collapsing the loop overhead instructions. Assume a one-cycle delayed branch. Show the schedule.

   (a) *This loop computes* $Y[i] = a \times X[i] + Y[i]$, *the key step in a Gaussian elimination*

```
loop:   LD      F0,0(R1)
        MULTD   F0,F0,F2
        LD      F4,0(R2)
        ADDD    F0,F0,F4
        SD      0(R2),F0
        SUBI    R1,R1,8
        SUBI    R2,R2,8
        BNEZ    R1,loop
```

   After unrolled:

```
loop:   LD      F0,0(R1)
        LD      F5,-8(R1)
        MULTD   F0,F0,F2
        MULTD   F5,F5,F7
        LD      F4,0(R2)
        LD      F9,-8(R2)
        ADDD    F0,F0,F4
        ADDD    F5,F5,F9
        SUBI    R1,R1,16
        SUBI    R2,R2,16
        SD      16(R2),F0
        BNEZ    R1,loop
        SD      8(R2),F5
```

   (b) *This loop computes a dot product*

```
loop:   LD      F0,0(R1)
        LD      F4,0(R2)
        MULTD   F0,F0,F4
        ADDD    F2,F0,F2
        SUBI    R1,R1,8
        SUBI    R2,R2,8
        BNEZ    R1,loop
```

   After unrolled:

```
        loop:   LD      F0,0(R1)
                LD      F5,8(R1)
                LD      F4,0(R2)
                LD      F9,8(R2)
                MULTD   F0,F0,F4
                MULTD   F5,F5,F9
                SUBI    R1,R1,16
                SUBI    R2,R2,16
                ADDD    F2,F0,F2
                BNEZ    R1,loop
                ADDD    F7,F5,F7
 out_of_loop:   ADDD    F2,F7,F2
```