ECEN 651 Exam 1 Zhenlei Song

1. Computer A:

average running time:

$1 \times 30\% + 4 \times 18\% + 3 \times 20\% + 2 \times 32\%$

$= 2.26$ cycles

for computer B

plan 1: $1 \times 30\% + 4 \times 18\% + 3 \times 20\% + 1 \times 32\%$

$= 1.94$ cycles

plan 2: $1 \times 30\% + 2 \times 18\% + 3 \times 20\% + 2 \times 32\%$

$= $ ~~2.2 cycles~~ 1.9 cycles

plan 2 will be better

in percentage 32% is more common, but for same 50% raise in performance, loads can improve 2 cycles. Still pban 2 has better result.

2.

(a) IBM3090 $\frac{3.27 + 13.4 + 57.5}{3} = 24.725$

M/2000 $\frac{5.3 + 22.6 + 110}{3} = 45.975$

$\frac{T_{M/2000}}{T_{IBM3090}} = 1.86$ 1.86 times faster

(b) $Speed_{overall} = \frac{1}{(1-0.8) + \frac{0.8}{2}} = \frac{5}{3}$

$\frac{92.5 \times \frac{3}{5} + 407.2 + 1872}{3} = 781.55$

(c) Arth average : $0.15 \times 5.3 + 0.77 \times 22.6 + 0.08 \times 110$

$= 26.995$

(d) geometric mean $= \sqrt[3]{5.3 \times 22.6 \times 110}$

$= 23.625$

3. ADD R1, 40(R3), R2

3. loop times 100

4. (a) ~~dy~~ in each loop nop x2

200

(b)

	DADDI	1
	LW	1
L1 :	SLTI	2 x 100
	BEQ	2 x 100
	LW	2 x 100
	DSUB	3 x 100
	SW	2x 100
	DADDI	2x 100

total 1302

(c)

	LW	1
L1 :	LW	1 x 100
	SW	1 x 100
	J	1 x 100
	BEQ ... L2	1

302 in total

5.

```
L1:   SGE   R2, R1, R4
      BNE   R2  R0  END
      LW    R3, 0(R1)
      LW    R5, 2000(R2)
      ADD   R6  R6  R3
      ADD   R7  R7  R5
      J     L1
      ADDI  R1  R1  #4
END:  END   ADD   R7  R6  R7
```

(a) ~~hazard~~ RAW hazard between LW R3, 0(R1) and ADD R6, R6, R3

R3 value may be old when reading thus RAW hazard happens

(b) shown above

(c) In this case, instruction J L1 and ADDI R1 are not actually processing data before unrolling 2/8 = 25% loop overhead in L1

without unrolling, it will be like

```
SGE ...
BNE ...
LW  R3, 0(R1)
ADD R6, R6, R3
J   L1
ADDI R1, R1, #4
```

2/6 = 33.3% loop overhead non-unrolled

b.

```
A[1] = B[1] + C[1];

for (i = 1; i <= 99; i = i+1) {
    C[i+1] = B[i+1] + C[i+1] + D[i];
    A[i+1] = B[i+1] + C[i+1];
}
C[101] = C[101] + D[100];
```