22C:160/55:132 High Performance Computer Architecture
Homework 4
Assigned April 6, 06
Due April 13, 06
Total Points = 50
There are three questions.

Question 1 (15 points)
Convert the numbers 123.4 and 345.6 into binary single precision FP format (IEEE 754). Add the two FP numbers, and write down the sum in binary single precision FP format (IEEE 754). Finally convert it back to decimal, and verify that the result = 469.0.

Show your calculations.

Question 2. (20 points) Consider the following loop that manipulates the elements of two arrays X and Y.

```
for (k=0; k<100; k=k+1){
        X(k) := X(k)+1
        Y(k):= Y(k)+X(k)
        Z(k) := Y(k)+2
}
```

Use software pipelining to improve the ILP, and show the restructured loop. Do not convert the statements into assembly language instructions.

Question 3. **(15 points)** Recall the use of a branch target buffer for branch prediction in high performance processors. Now, make the following assumptions:

BTB hit rate = 95%
For instruction in the buffer, the prediction accuracy = 80%
Assume that 50% of the branches are taken.
Penalty for incorrect prediction during BTB hit = 2 cycles (includes BTB entry update)
Penalty for taken branches after BTB miss = 2 cycles (includes BTB entry update)

Calculate the average penalty (in cycles) per branch. Explain your calculations.

(Before answering this question, review how a BTB works)