1 (50 pts) For the following repeating pattern (e.g., in a loop) of branch outcomes:

NT, NT, NT, T, T, NT, NT, NT, T, T

a. (10 pts) What is the accuracy of always-taken and always-not-taken predictors for this sequence of branch outcomes?

b. (20 pts) What is the accuracy of a one-bit predictor assuming the predictor starts in the predict-taken state. What is the accuracy of this predictor if this pattern repeats forever?

c. (20 pts) What is the accuracy of a two-bit dynamic branch predictor assuming that the predictor starts off in the weakly predict-not-taken state? What is the accuracy of this predictor if this pattern is repeated forever?

2. (30 pts) Briefly discuss the BHT (Branch History Table) and BTB (Branch Target Buffer). Please cover the following aspects in your answer:
What are they used for? What are the entries in them? How to get the right entry in BTB and BHT (addressing)? How BTB and BHT work together to do branch prediction?

3. (20 pts) Assume the 2-bits branch predictor accuracy is 85%. Some branch instructions are much more predictable than others. If we know that 80% of all executed branch instructions are easy-to-predict loop-back branches that are always predicted correctly, what is the accuracy of the 2-bit predictor on the remaining 20% of the branch instructions?