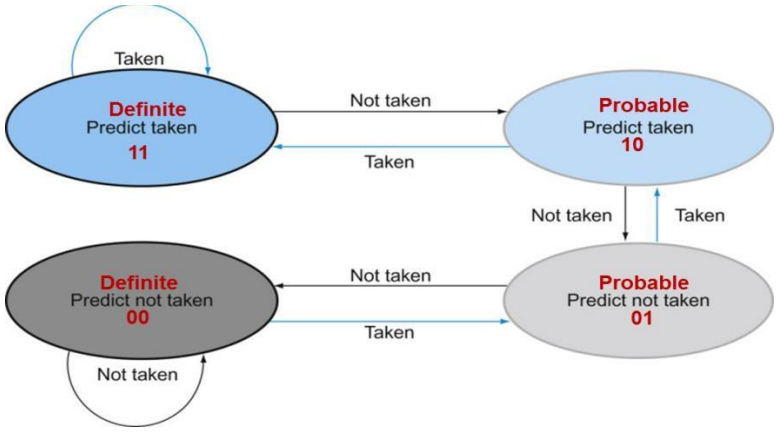
CE/CZ3001: Advanced Computer Architecture:

Tutorial-5

1. This exercise examines the accuracy of various branch predictors for the following pattern of branch outcomes:

   (i) T, T, NT, T
   (ii) T, T, T, NT, NT

   a) What is the accuracy of always-taken and always-not-taken predictors for this sequence of branch outcomes?
   b) What is the accuracy of the two-bit predictor, assuming that the predictor starts in the bottom left state (predict not taken:00) from the Figure below.



   c) What is the accuracy of the two-bit predictor if the given patterns are repeated forever?

   (Answer: a) (i) 75%, 25% (ii) 60%, 40%, b) (i) 0% (ii) 20%, c) (i)75% (ii) 40%)

2. Analyse the code given below.

```
        ADDI X10, X31, #X       # save loop termination index
loop:   LDUR X1, [X11, #0]      # X1 = b[i]
        ADD X1, X1, X12         # X1 = b[i]+c
        STUR X1, [X11, #0]      # store X1 to address of b[i]
        SUBI X10, X10, #1       # X10 = X10-1
        ADDI X11, X11, #8       # X11 = address of b[i+1]
        CBNZ X10, loop          # if (X10 != 0)  go to loop
finish: ……..
```

   a) Calculate the CPI for X = 5 and for X=100? Note that data forwarding is not done but register-write and decode of different instructions can be performed in the same clock cycle.
   b) Unroll the loop in the code given above (X=100), by a factor of 4, and show how loop unrolling combined with instruction reordering helps to improve the CPI of the system. Note that data forwarding is not done but register-write and decode of different instructions can be performed in the same clock cycle.
   (Answer: a) 1.9677, 1.998 b) CPI will be reduced.)