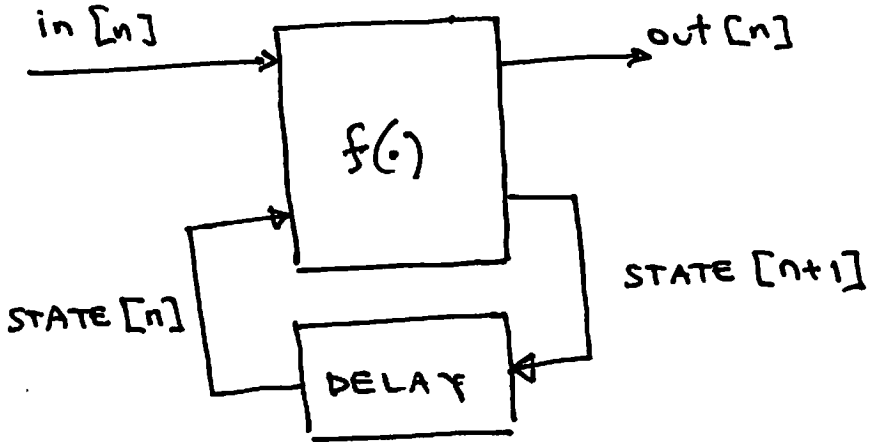
VITERBI ALGORITHM (HARD/SOFT)

GIVEN: A STATE MACHINE (~"STATE SPACE MODEL")



+ INITIAL STATE STATE [0]

+ CUMULATIVE BRANCH METRIC

$$\varrho_n = \varrho_n(\text{STATE}[n], \text{in}[n]) \quad (n=0,1,\dots N)$$

FIND: INPUT SEQUENCE $\{\text{in}[n]\}_{n=0}^{N}$

TO MINIMIZE

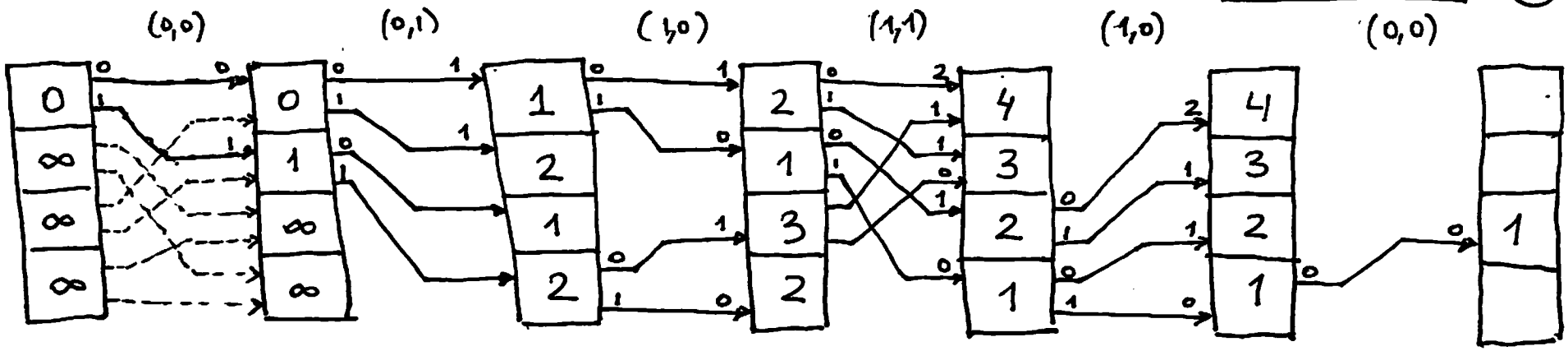
$$\sum_{n=0}^{N} \varrho_n(\text{STATE}[n], \text{in}[n]) = \varrho_0(\text{STATE}[0], \text{in}[0]) + \varrho_1(\text{STATE}[1], \text{in}[1]) + \dots + \varrho_N(\text{STATE}[N], \text{in}[N])$$

TYPICAL: $\varrho_n(\text{STATE}[n], \text{in}[n])$

$$= \text{distance}(\text{OUT}[n], Y_0[n])$$

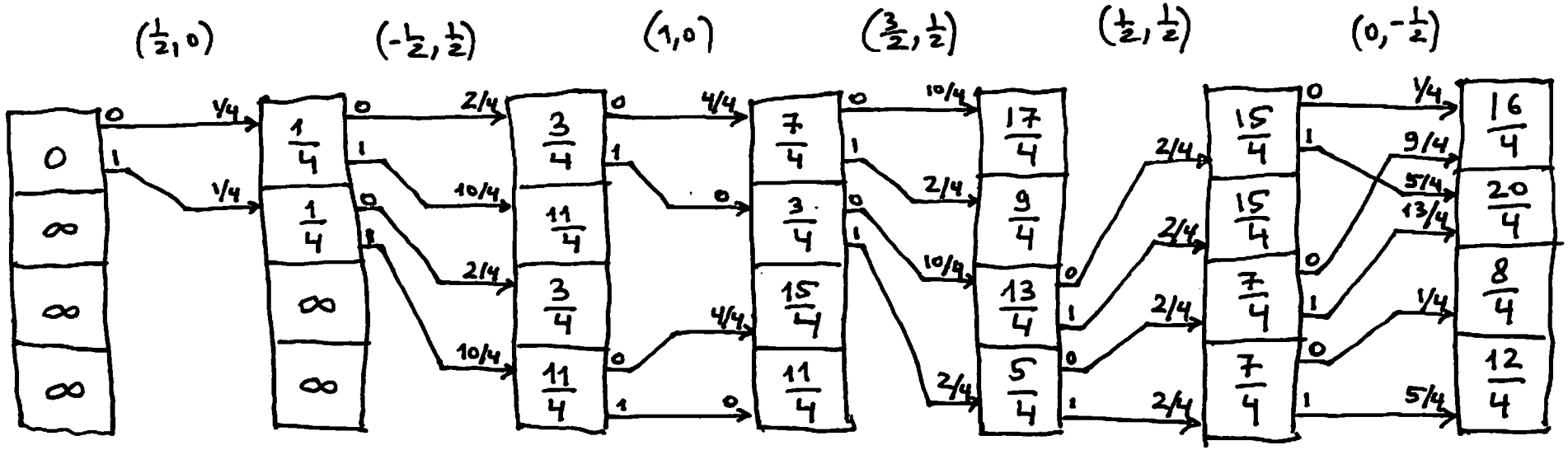
OUT[n]: A FUNCTION OF STATE[n] ANT in[n]

$Y_0[n]$: GIVEN



DECODED: 0 0 1 1 1 0

TOTAL ERROR: 1



DECODED: 0 0 1 1 1 0

TOTAL ERROR (SQUARED): 2

$r=2, k=2, h_1[n]=\delta[n], h_2[n]=\delta[n-1]+\delta[n-2]$ 6.02/12.10.2010

Ex 1: $\text{OUT}[n] = (x[n],\ x[n-1]+x[n-2])$ $(x[n] \equiv i_n[n])$

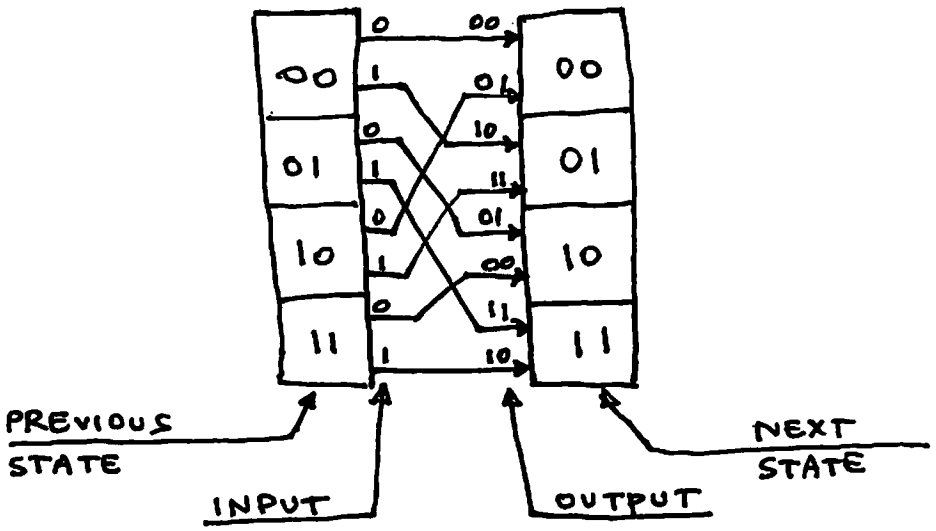
IS THIS A STATE MACHINE?

YES, BECAUSE EVERY CONVOLUTIONAL CODE IS

STANDARD STATE: $\text{STATE}[n] = (x[n-2], x[n-1])$

WHY NOT $\text{STATE}[n] = x[n-2]+x[n-1]$?

BECAUSE $x[n]+x[n-1]$ IS NOT A FUNCTION OF $X[n]$ AND $x[n-2]+x[n-1]$!



Ex. 1A: MINIMAL HAMMING DISTANCE TO $\overbrace{[(00),(01),(10),(11),(10),(00)]}^{y_0}$

Ex. 1B: MINIMAL DISTANCE TO $\underbrace{[(\tfrac{1}{2},0),(-\tfrac{1}{2},\tfrac{1}{2}),(1,0),(\tfrac{3}{2},\tfrac{1}{2}),(\tfrac{1}{2},\tfrac{1}{2}),(0,-\tfrac{1}{2}$

y_0

$$g_n(\text{STATE}[n], in[n]) = \left|\text{OUT}[n] - Y_0[n]\right|$$

$N = 5$