Andrew McClelland
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ELEC 425 – Assignment 3

1 – Calculate Joint Probabilities in HMM

$$p(x,z) = P(z_1 = F) \times P(1|F) \times P(F|F) \times P(2|F) \times P(L|F) \times P(6|L) \times P(F|L) \times P(3|F) \times P(F|F) \times P(6|F)$$

$$p(x,z) = \left(\frac{1}{2} \times \frac{1}{6}\right) \times \left(0.6 \times \frac{1}{6}\right) \times \left(0.4 \times \frac{1}{2}\right) \times \left(0.4 \times \frac{1}{6}\right) \times \left(0.6 \times \frac{1}{6}\right)$$

$$p(x,z) = 1.11 \times 10^{-5}$$

2 - Viterbi algorithm

Please find the manually filled out Viterbi algorithm tables below. Please note, as requested, the original values for the V matrix were used, not the log values.

Table 1 - The V Matrix

	t = 1	*t = 2*	*t = 3*
K = 1 (Fair)	$V_{k=1}(1) = \frac{1}{12}$	$V_{k=1}(2) = \frac{1}{6} \times \max\left(\frac{1}{12} \times 0.6, \frac{1}{20} \times 0.4\right)$ $V_{k=1}(2) = \frac{1}{6} \times \frac{1}{20} = \frac{1}{120} = 0.008\bar{3}$	$V_{k=1}(3) = \frac{1}{6} \times \max\left(\frac{1}{120} \times 0.6, \frac{1}{300} \times 0.4\right)$ $V_{k=1}(3) = \frac{1}{6} \times \frac{1}{200} = \frac{1}{1200} = 0.00083\bar{3}$
K = 2 (Loaded)	$V_{k=2}(1) = \frac{1}{20}$	$V_{k=2}(2) = \frac{1}{10} \times \max\left(\frac{1}{12} \times 0.4, \frac{1}{20} \times 0.6\right)$ $V_{k=2}(2) = \frac{1}{10} \times \frac{1}{30} = \frac{1}{300} = 0.00\bar{3}$	$V_{k=2}(3) = \frac{1}{2} \times \max\left(\frac{1}{120} \times 0.4, \frac{1}{300} \times 0.6\right)$ $V_{k=2}(3) = \frac{1}{2} \times \frac{1}{300} = \frac{1}{600} = 0.001\bar{6}$
Observation	***"1"***	***"2"***	***"6"***

Table 2 - The Ptr Matrix

	t = 1	*t = 2*	*t = 3*
K = 1 (Fair)	0	1	1
K = 2 (Loaded)	0	1	1
Observation	***"1"***	***"2"***	***"6"***

$$z^* = F\ F\ L$$

$$p(x,z^*) = \frac{1}{12} \times \frac{1}{120} \times \frac{1}{600} = \frac{1}{864{,}000}$$

3 – Feed Forward Neural Networks

Please find the relevant files in the submitted *.zip* folder.