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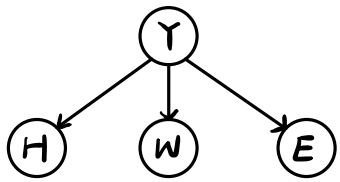
Q1.(a). Graph structure:



$Y \in \{spam, ham\}$

Parameters:

$P(Y=spam)$, $P(H_t|Y)$, $P(W=yes|Y)$, $P(E_t|Y)$. $H_t \in \{1,2,\cdots,23\}$ $E_t \in \{K,S\}$

Size of the set of parameters:

$1+23\times2+2+2\times2=53$

(b). $P(Y=spam)=\frac{1}{3}$, $P(H=3|Y=spam)=1$, $P(H=14|Y=spam)=\frac{1}{2}$

$P(H=15|Y=ham)=\frac{1}{2}$, $P(W=yes|Y=spam)=1$, $P(E=S|spam)=1$

$P(E=K|Y=ham)=1$

(c). No prediction since $E=U$ is not observed

(d). $P(Y=spam)=\frac{3}{7}$, $P(H=3|Y=spam)=\frac{3}{49}$, $P(H=other|Y=spam)=\frac{2}{49}$

$P(H=14|Y=ham)=\frac{3}{50}$, $P(H=15|Y=ham)=\frac{3}{50}$, $P(H=other|Y=ham)=\frac{1}{25}$

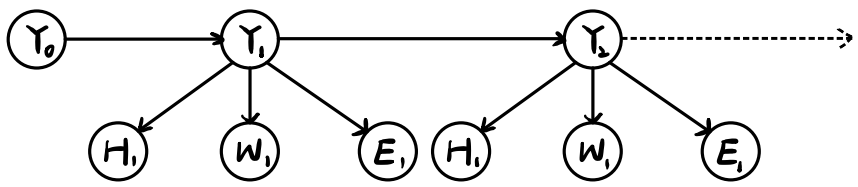
$P(W=yes|Y=spam)=\frac{3}{5}$, $P(W=yes|Y=ham)=\frac{1}{3}$

$P(E=S|Y=spam)=\frac{3}{7}$, $P(E=K|Y=spam)=\frac{2}{7}$

$P(E=K|Y=ham)=\frac{1}{2}$, $P(E=S|Y=ham)=\frac{1}{4}$

(e). Ham

(f). Graph structure:



Parameters: $P(Y_0=spam)$ $P(Y_i=spam|Y_{i-1})$ $P(H_i|Y_i)$ $P(W=yes|Y_i)$

$P(E_i|Y_i)$ $H_i \in \{1,2,\cdots,23\}$ $E_i \in \{K,S\}$

Size of the set of paramters: $2+53=55$

Q2 (a). A.

(b). (i). $f(x) = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$

(ii). not possible

(iii). $f(x) = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$

(iv). $f(x) = \begin{bmatrix} -1 \\ 0 \end{bmatrix}$

(v). not possible

(vi). $f(x) = \begin{bmatrix} 1 \\ -1 \\ 0 \end{bmatrix}$