Artificial Intelligence

— 98102284

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1.1

Bayesian network for each step of the problem is shown in figure 1.

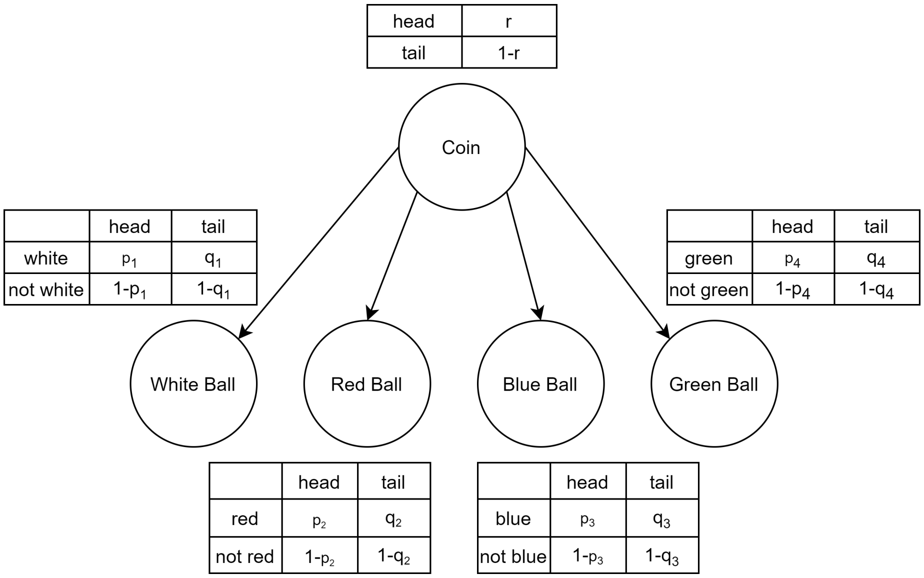

Figure 1: Bayes' network for each coin toss

1.2

$$P(\text{Isochromatic}|\text{TTH}) = A$$

$$\text{Isochromatic} : balls \in \{(w,w,w),(r,r,r),(b,b,b),(g,g,g)\}$$

$$\text{TTH} : coins = \{T,T,H\}$$

$$\Rightarrow A = \frac{P(\text{Isochromatic},\text{TTH})}{P(\text{TTH})}$$

$$= \frac{(1-r)^2 \times r \times (q_1q_1p_1 + q_2q_2p_2 + q_3q_3p_3 + q_4q_4p_4)}{(1-r)^2 \times r}$$

$$= q_1q_1p_1 + q_2q_2p_2 + q_3q_3p_3 + q_4q_4p_4$$

$$= q_1^2p_1 + q_2^2p_2 + q_3^2p_3 + q_4^2p_4$$

$$= \sum_{i=1}^{4} q_i^2 p_i$$

1.3

$$
\begin{gathered}
P(\mathrm{H}|\mathrm{Red}) = A \\
\mathrm{H} : coins = \{H\} \\
\mathrm{Red} : balls \in \{(r)\} \\
\Rightarrow A = \frac{P(\mathrm{H}, \mathrm{Red})}{P(\mathrm{Red})} \\
= \frac{rp_2}{rp_2 + (1-r)q_2}
\end{gathered}
$$