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$$(a) \text{Entropy}(\text{Sample}) = -\left(\frac{9}{14}\right) \log_2\left(\frac{9}{14}\right) - \left(\frac{5}{14}\right) \log_2\left(\frac{5}{14}\right) = 0.940$$

$$\text{Entropy}(\text{Sample}, \text{outlook}) = \left(\frac{5}{14}\right) * 2 * \left(-\frac{3}{5} \log_2\left(\frac{3}{5}\right) - \frac{2}{5} \log_2\left(\frac{2}{5}\right)\right) + \left(\frac{4}{14}\right) * 0 = 0.694$$

$$\text{Entropy}(\text{Sample}, \text{humidity}) = \frac{5}{14} * \left(-\frac{5}{4} \log_2\left(\frac{5}{4}\right) - \frac{1}{5} \log_2\left(\frac{1}{5}\right)\right) + \frac{9}{14} * \left(-\frac{4}{9} \log_2\left(\frac{4}{9}\right) - \frac{5}{9} \log_2\left(\frac{5}{9}\right)\right) = 0.895$$

$$\text{Gain}(\text{Sample}, \text{outlook}) = \text{Entropy}(\text{Sample}) - \text{Entropy}(\text{Sample}, \text{outlook}) = 0.940 - 0.694 = 0.246$$

$$\text{Gain}(\text{Sample}, \text{humidity}) = \text{Entropy}(\text{Sample}) - \text{Entropy}(\text{Sample}, \text{humidity}) = 0.940 - 0.895 = 0.045$$

$$(b) \text{GainRatio}(\text{Sample}, \text{humidity}) = \frac{\text{Gain}(\text{Sample}, \text{humidity})}{\text{Info}(\text{Sample}, \text{humidity})} = \frac{0.045}{-\left(\frac{9}{14}\right) \log_2\left(\frac{9}{14}\right) - \left(\frac{5}{14}\right) \log_2\left(\frac{5}{14}\right)} = 5\%$$

$$\text{GainRatio}(\text{Sample}, \text{outlook}) = \frac{\text{Gain}(\text{Sample}, \text{outlook})}{\text{Info}(\text{Sample}, \text{outlook})} = \frac{0.246}{-\left(\frac{4}{14}\right) \log_2\left(\frac{4}{14}\right) - \left(\frac{5}{14}\right) \log_2\left(\frac{5}{14}\right) * 2} = 16\%$$

