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**Question 1.** (5 points)

Agent receives rewards as follows:

$$r_k = \begin{cases} 0; & \text{if } y_k = 0 \\ 1; & \text{if } y_k = 1 \text{ and } k = 1 \\ 2r_{k-1} \text{ with probability } \frac{1}{2}; & \text{if } y_k = 1 \text{ and } k > 1 \\ \frac{1}{2}r_{k-1} \text{ with probability } \frac{1}{2}; & \text{if } y_k = 1 \text{ and } k > 1 \end{cases} \quad (1)$$

Determine  $U^{y \leq 3}$  of  $y_1 = y_2 = y_3 = 1$ .

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**Question 2.** (10 points)

Agent receives rewards as follows:

$$r_k = \begin{cases} 0; & \text{if } y_k = 0 \\ 1; & \text{if } y_k = 1 \text{ and } k = 1 \\ r_{k-1} + 1 \text{ with probability } \frac{1}{2}; & \text{if } y_k = 1 \text{ and } k > 1 \\ r_{k-1} - 1 \text{ with probability } \frac{1}{2}; & \text{if } y_k = 1 \text{ and } k > 1 \end{cases} \quad (2)$$

Determine  $U^{y \leq \infty}$  of  $y_{\leq \infty} = 1, 1, \dots$  for  $\gamma = \frac{1}{2}$ .