Jester in the Dark

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g_1 : First drawn coin is gold
g_2 : Second drawn coin is gold
c_1 : Chest with 2 gold coins is open
c_2 : Chest with 1 gold and 1 silver coin is open
c_3 : Chest with 2 silver coins is open

	c_1	c_2	c_3
g_1	$\frac{2}{6}$	$\frac{1}{6}$	$\frac{0}{6}$
$\bar{g_1}$	$\frac{0}{6}$	$\frac{1}{6}$	$\frac{2}{6}$

	c_1	c_2	c_3
g_2	$\frac{2}{6}$	$\frac{1}{6}$	$\frac{0}{6}$
$\bar{g_2}$	$\frac{0}{6}$	$\frac{1}{6}$	$\frac{2}{6}$

$$P(g_2|g_1) = \sum_{i=1}^{3} P(g_2, c_i|g_1) \tag{1}$$

$$P(g_2|g_1) = \sum_{i=1}^{3} P(g_2|c_i, g_1)P(c_i|g_1) \tag{2}$$

$$P(g_2|c_1, g_1) = 1 \tag{3}$$

$$P(g_2|c_2, g_1) = 0 \tag{4}$$

$$P(g_2|c_3, g_1) = 0 \tag{5}$$

$$P(c_i|g_1) = \frac{P(g_1|c_i)P(c_i)}{P(g_1)} \tag{6}$$

$$P(c_i) = \frac{1}{3} \tag{7}$$

$$P(g_1|c_1) = 1 \tag{8}$$

$$P(g_1|c_2) = \frac{1}{2} \tag{9}$$

$$P(g_1|c_3) = 0 \tag{10}$$

$$P(g_1) = \sum_{i=1}^{3} P(g_1|c_i)P(c_i) \tag{11}$$

$$P(g_1) = \frac{1}{3}\left(1 + \frac{1}{2} + 0\right) = \frac{1}{2} \tag{12}$$

$$P(c_1|g_1) = \frac{P(g_1|c_1)P(c_1)}{P(g_1)} = \frac{2}{3} \tag{13}$$

$$P(c_2|g_1) = \frac{1}{3} \tag{14}$$

$$P(c_3|g_1) = 0 \tag{15}$$

$$P(g_2|g_1) = (1 * \frac{2}{3}) + (0 * \frac{1}{3}) + (0 * 0) = \frac{2}{3} \tag{16}$$