Exercise: Total probability theorem

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2.0/2.0 points (graded)

We have an infinite collection of biased coins, indexed by the positive integers. Coin i has probability 2^{-i} of being selected. A flip of coin i results in Heads with probability 3^{-i}. We select a coin and flip it. What is the probability that the result is Heads? The geometric sum formula may be useful here: $\sum_{i=1}^{\infty} \alpha^i = \frac{\alpha}{1-\alpha}$, when $|\alpha| < 1$.

The probability that the result is Heads is: 0.2

Answer: 0.2

Answer:
We think of the selection of coin i as scenario/event A_i. By the total probability theorem, for the case of infinitely many scenarios,

$$\mathbf{P}(\text{Heads}) = \sum_{i=1}^{\infty} \mathbf{P}(A_i)\mathbf{P}(\text{Heads} \mid A_i) = \sum_{i=1}^{\infty} 2^{-i}3^{-i} = \sum_{i=1}^{\infty} (1/6)^i = \frac{1/6}{1-(1/6)} =$$

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