Problem 9: Recursive Reasoning: Scalar Implicature

This is an expressiveness challenge.

Given:

Two mutually-recursive models (of a speaker and a hearer). There is a world in which there are three seeds that may have sprouted, so the world is in one of four states: 0 seeds sprouted, 1 seed sprouted, 2 seeds sprouted, or 3 seeds sprouted. The speaker observes this world and wishes to communicate the state to the hearer (who does not directly observe the world). The speaker can say one of three possible sentences: “All of the seeds have sprouted”, “Some of the seeds have sprouted”, or “None of the seeds have sprouted”. The speaker should choose the utterance that is most likely to cause the hearer to infer the correct state of the world. The hearer is supposed to infer the state of the world based on what the speaker is saying knowing that the speaker is trying to communicate the correct state of the world (hence the recursion). Assume a uniform prior on the four possible states of the world.

Do:

Express this problem in the PPS with an explicit limit on the degree of the recursion. If the speaker says “Some of the seeds have sprouted” and the recursion is at least of depth 2, then the model should infer that with high probability the world is in either states 1 or 2 but not state 3 (because the speaker would have said “All of the seeds have sprouted” instead).

This is an expressiveness challenge, so no performance statistics are required. It is sufficient to show that your PPS can compute the correct answer.

For more detail on this and related problems, see https://probmods.org/inference-about-inference.html

Submission:

This problem is an expressiveness challenge. The primary requirement is to demonstrate a probabilistic program and show that it runs and computes the right answer. Teams should submit their source code as file “problem-9-solution.tar”. Teams may optionally produce performance profiles for a metric of their choice. Please define the metric in a file named “problem-9-query-q-metric.pdf”.