Small Problem 5: Probabilistic Context-Free Grammar Sentence Completion

In this problem, you are given a probabilistic context free grammar and a prefix of a string generated by that grammar. Your goal is to evaluate the conditional probability that the grammar will generate the complete string for a given suffix : .

Grammar: Note that this grammar produces strings of unbounded length, but produces a finite string with probability 1.

S → AB (0.25)

S → BC (0.2)

S → AC (0.4)

S → CA (0.15)

A → a (0.05)

A → b (0.3)

A → S (0.65)

B → b (0.5)

B → c (0.3)

B → d (0.2)

C → d (0.35)

C → e (0.1)

C → S (0.55)

Query 1: What is the conditional probability that a string beginning with “bd” terminates with the complete string “bdcb”: where is the complete string that is generated by S.

Query 2: What is ?

Metric: Square of the difference in negative log probability (“surprise”) between the true and the computed conditional probability. .