

Exercises for SPAß: Statistics, Probability and Algorithms in Bioinformatics

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Problem set 9 · Handed out on 17.12.2003

Please hand in solutions by 7.1.2003 · Late solutions will not be accepted

Problem 30 (Forward and Viterbi Algorithms). Remember HMMs from the Algorithmic Bioinformatics lecture? Define some sensible notation, and write down the Viterbi algorithm and Forward algorithm *explicitly* for the case where *all* probabilities, including state transition and emission probabilities, are stored in memory as (natural) logarithms.

Problem 31 (Geometric, Exponential, and Gamma distributions). Write a short pedagogical paper clarifying the relationships between the following distributions: geometric, geometric0, exponential, discrete gamma, negative binomial, gamma. Also try to highlight the relationships between their parameters.

Problem 32 (Random points in a disc). You want to pick a random point from the two-dimensional disc D_r with radius r around the origin: $D_r = \{(x, y) : x^2 + y^2 \leq r^2\}$. “Random” refers to the uniform distribution, i.e., for any sub-area A of the disc we want $\mathbb{P}((x, y) \in A) = |A|/(\pi r^2)$. Professor Square suggests to draw R uniformly in $[0, r]$, Θ uniformly in $[0, 2\pi]$, and to let $X := R \cdot \cos \Theta$, $Y := R \cdot \sin \Theta$. Show that this does *not* generate a uniform point in the disc. What’s the correct method? You can visualize this with a simulation study in MATLAB.

All of the above problems are for extra credit.

