Welcome Tutorial :-)

Tutorial 3

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1. If X_i are i.i.d. with $P(X_i = 1) = p$ and $P(X_i = 0) = 1 - p$, then $S_n = \sum_{i=1}^{n} X_i$ is a random walk (Markov chain) on $\mathbb{Z}$. Please write down the transition matrix of the random walk.
2. Suppose X is a Possion random variable (i.e., $P(X = x) = \frac{\lambda^x}{x!} e^{-\lambda}$), which is a distribution from Exponential family. Please rewrite the PMF in the standard form of Exponential family.
3. A PDF or PMF in Exponential family can be written in form $Exp(\theta^T \phi(x) - A(\theta))$. Please prove that $\frac{\partial}{\partial \theta_i} A(\theta) = E(\phi(x)(i))$.
4. Please factorize the joint distributions of the graphical model as shown in Figures 1 and 2. (Note that Fig. 1 shows that a sample of N points generated from a Gaussian with parameters μ and σ^2, where μ and σ^2 are treated as r.v.s, and Fig. 2 shows a Hidden Markov Model).

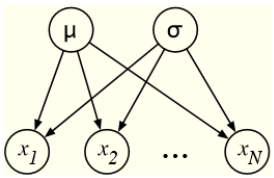

Fig. 1

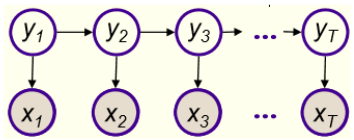

Fig. 2