T-79.5102 **Autumn 2008**
Special Course in Computational Logic
Tutorial 5

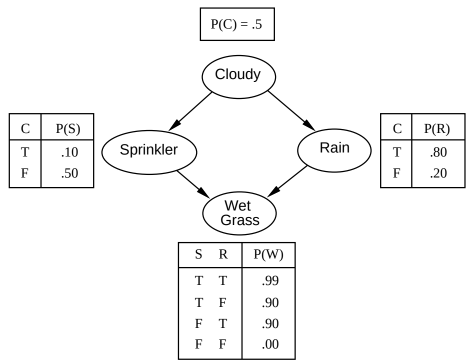
1. Consider the query $\mathbf{P}(Rain \mid Sprinkler = true, WetGrass = true)$ for the network given below and how MCMC can answer it.

(a) How many states does the Markov chain have?

(b) Calculate the transition matrix Q containing $q(\mathbf{x} \to \mathbf{x}')$ for all states $\mathbf{x}$ and $\mathbf{x}'$.

(c) What does the square of the transition matrix Q^2 represent?

(d) What about Q^n as $n \to \infty$.



(R&N, Exercise 14.11.abcd)

2. A fire station has one fire truck. Upon an emergency call, the truck goes out to fight fire and then returns to the station.

(a) Design a hidden Markov model (HMM) with two states *fs* (the truck is at the fire station) and $\neg$*fs* to describe the behaviour of this system. Choose transition probabilities to reflect the following properties of the domain.
— On the average, there is an alert once in twelve hours.
— The expected duration for one fire mission is 3 hours.
Use one hour time slices in your model.

(b) Write down the corresponding transition matrix Q for the HMM as well as the transition model

$$\mathbf{P}(FS_{t+1} \mid FS_t)$$

using a Boolean random variable FS.

(c) Use the model to determine how many hours a day the truck spends at the fire station in the long run?

(d) Given a parametrised prior distribution $\mathbf{P}(FS_0) = \langle r, 1-r \rangle$, derive an exact expression for the distribution $\mathbf{P}(FS_t)$ as a function of t using the transition model and prediction.

(e) Does $\mathbf{P}(FS_t)$ converge as t approaches to infinity?