IN408 - PGM - Readings 24/04/2020

(L1) - introduction

Jordan (2004):

(W): I don't understand the significance of kernels in the PGM specification

(W): It is not fully specified how the assertions of conditional independence in directed and undirected graphs differ (i.e. arrows/edge)

(W): I don't fully understand how we move from the formalism for cliques C → formalism for factors
(undirected graph) (factor graph)

(W): Conversion of directed → undirected formalism ; work with (2) ~~i.e.~~

(3): 3.1 exact algorithms

- Not entirely sure now/needs investigation of distributive law for marginalisation of $p(x_1)$ i.e. now

$$p(x_1) = \sum_{x_2} \sum_{x_3} \sum_{x_4} \dots \sum_{x_6} \frac{1}{Z} \psi(x_1, x_2)\psi(x_1, x_3)\psi(x_2, x_4)\psi(x_3, x_5)\psi_{8}(x_2, x_5, x_6)$$

3.3 simplified

(W): Key terminology :- elimination order, triangulation algorithm, tree width

(W): At a high-level, what is stated in this algorithm is an efficient way of reducing the computational complexity of marginalising a joint probability distr

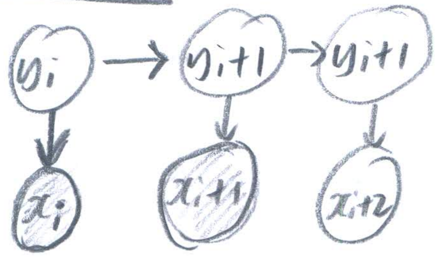
- Rest is details, machinery for doing so. (exact elimination algorithm)
- Elimination algorithm → sum-product → junction-tree algorithm.

• To run; determine how 'loaded' die is.

Inference/learning: QB - How loaded is the die; how fair is the die, how often does the regime switch.

· These are 'layman' questions; think in terms of variable-structure-prob.

· Let's formalise: - Remember r.v.s denote events (knowledge engineering)



(GM that reflects our story; but not exhaustively)

(one way of setting up)

· HMM ✓✓

· Shaded → observed, so observation x_i is observed; y_i latent (1/0 fair die)

(shown face of a die)

· $x_i \in [1,2,3,4,5,6]$

· $y_i \in [0,1]$

Structure: causal, generative, coupling

· There are many ways to of 'cutting the cake' for an observer-relative specification e.g. specification of params. / r.v.s. etc.; but have to deal appropriately with requisite complexity

· Need sequential evolution: add y_{i+1}, x_{i+1}

· How about selecting loaded, die - independent; or dependent event?

- If we keep choice of fair/loaded depended on previous choice of die; then we have about GM structure

- Markovian property: 1st order; immediate future $(i+1)$ independent of immediate past $(i-1)$ given present (i)

- HMM very widely used for modelling dependencies (Blackjack?)

Ex: Begin with joint distri:- $p(\underline{x}, y)$

· A sequence $\underline{x} = (x_1, \ldots, x_T)$ and parse $y = (y_1, \ldots, y_T)$

$p(\underline{x}, y) = p(x_1, \ldots, x_T, y_1, \ldots, y_T)$ - use factorisation using marg, cond. for parts

$= p(y_1)\, p(x_1|y_1) \ldots p(y_T|y_{T-1})\, p(x_T|y_T)$