

## **Further structure underlying the beta (and Indian buffet) process**

Daniel Roy, University of Cambridge

We uncover a novel urn scheme underlying conditionally independent sequences of Bernoulli processes that share a common beta process hazard measure. As shown by Thibaux and Jordan (2007), in the special case when the underlying beta process has a constant concentration function and a finite and non-atomic base measure, the combinatorial structure is that of the Indian buffet process (IBP) introduced by Griffiths and Ghahramani (2005). By reinterpreting the beta process introduced by Hjort (1990) as a continuum of Dirichlet processes, we obtain a simple predictive rule for the general case, and then show that a continuum of Pitman-Yor processes recovers a three-parameter variant of the IBP introduced by Teh and Gorur (2009) that exhibits power-law behavior, as further studied by Broderick, Pitman and Jordan (2012). The idea extends to arbitrary exchangeable partition probability functions, and beyond. In the same way that hierarchies of Dirichlet processes can be given Chinese restaurant franchise representations as shown by Teh, Jordan, Beal and Blei (2006), one can construct representations of hierarchies of beta processes using the stochastic process we uncover. This new perspective has obvious implications for inference algorithms.