github.com/afarah18/HBA-for-GWs-tutorial

Tutorial: Hierarchical Bayesian Analysis for GW Population Inference

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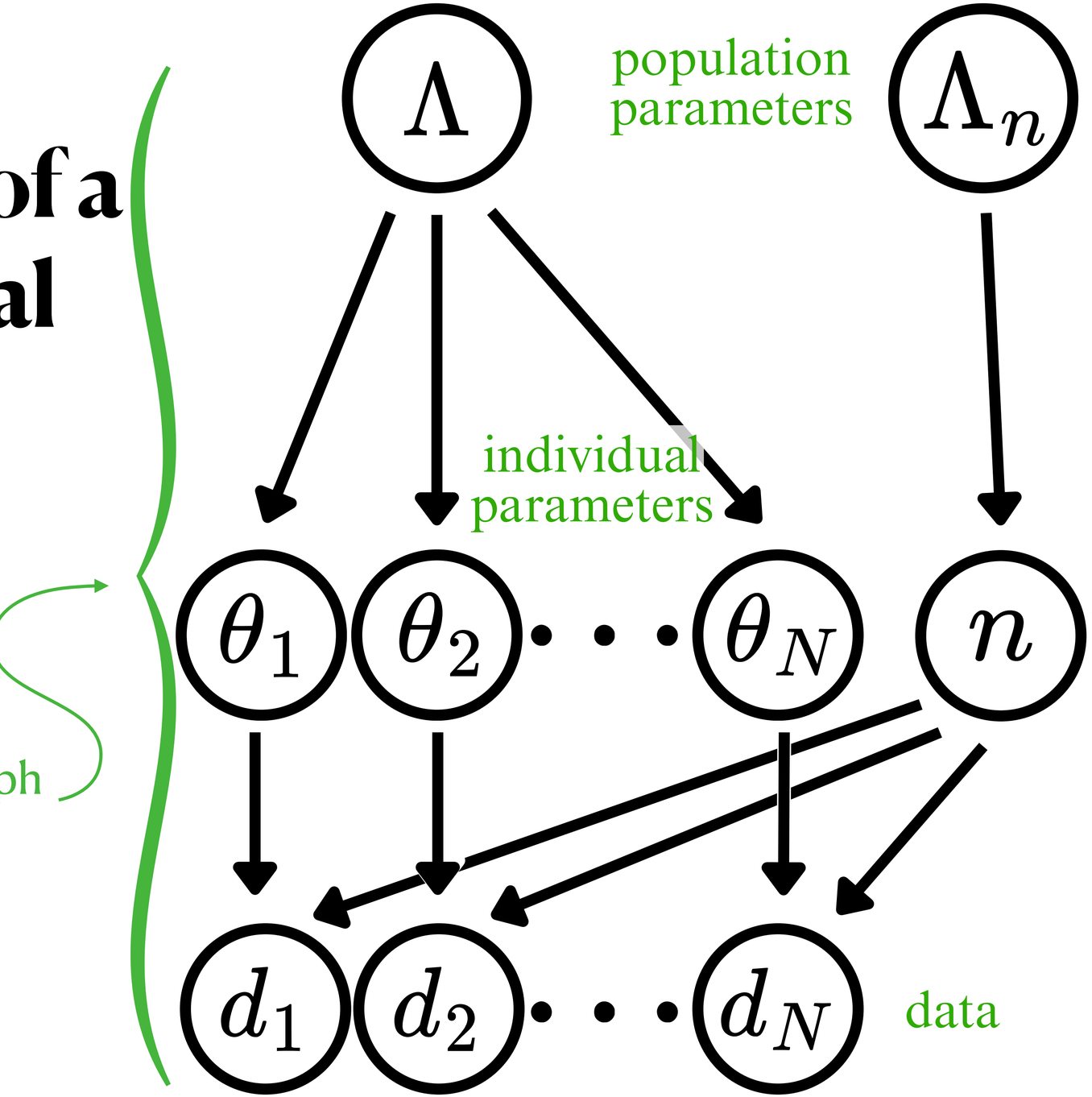
Structure of a hierarchical Bayesian analysis



Directed Acyclic Graph (DAG)

Top level:
Properties of the Universe (including the detector)

Middle level:
Properties of individual CBCs, and the noise realization

Bottom level:
Observed data

The joint (aka population) likelihood

- Observation of GWs from CBCs is an *inhomogeneous* Poisson process:

Number of observed GW events

Expected number of observations

Merger rate density

$$p(\{d\} \mid \{\theta\}, \Lambda) \propto e^{-N_{\mathrm{exp}}(\Lambda)} \prod_{i}^{N_{\mathrm{ev}}} p(d_i \mid \theta_i) \frac{\mathrm{d}N}{\mathrm{d}\theta}(\theta_i; \Lambda)$$

Likelihood of observing the data from event i given that event's parameters

- Implementation:

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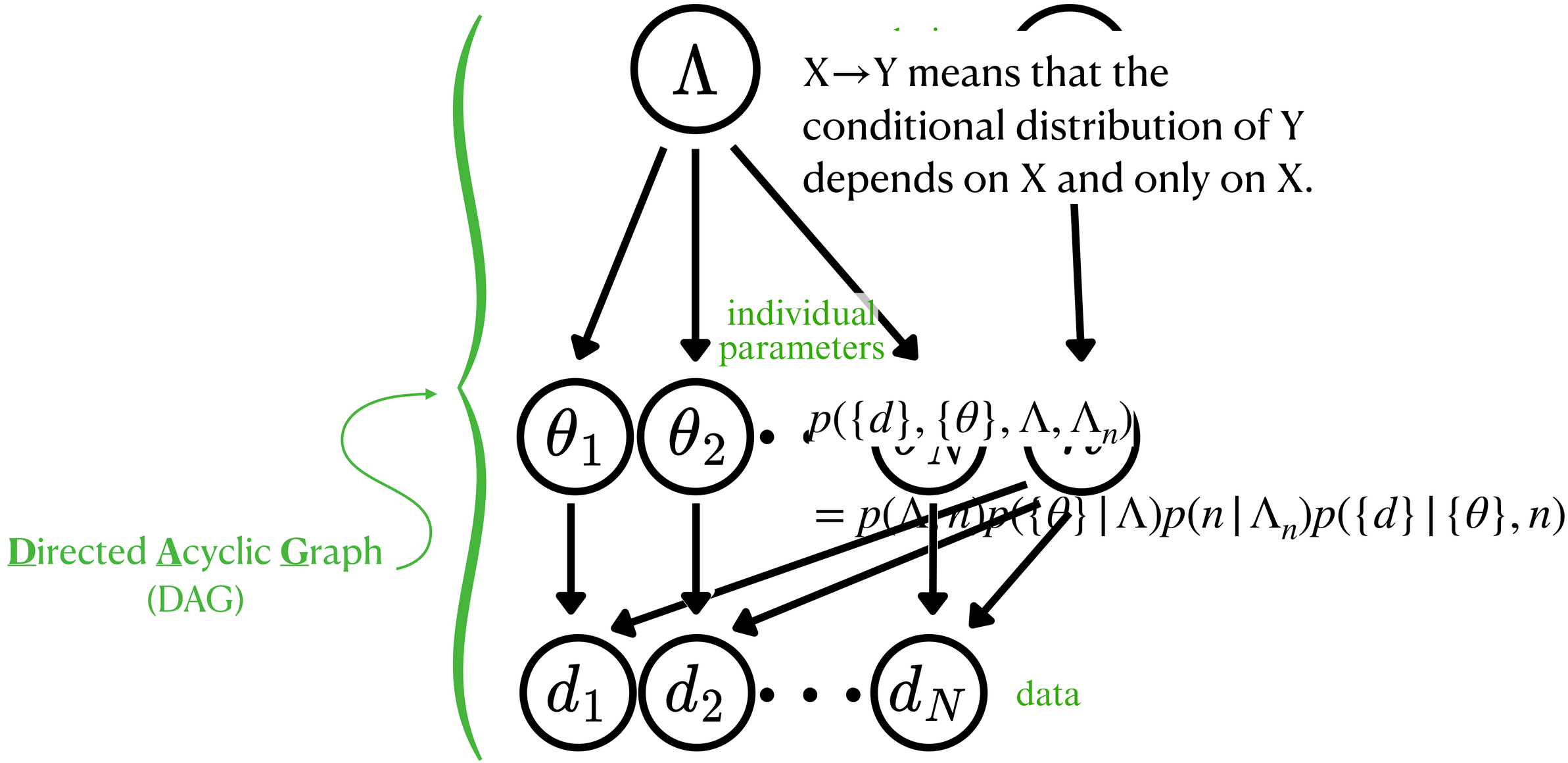
Bonus: Getting joint posteriors from DAGs



Note on MC Variance