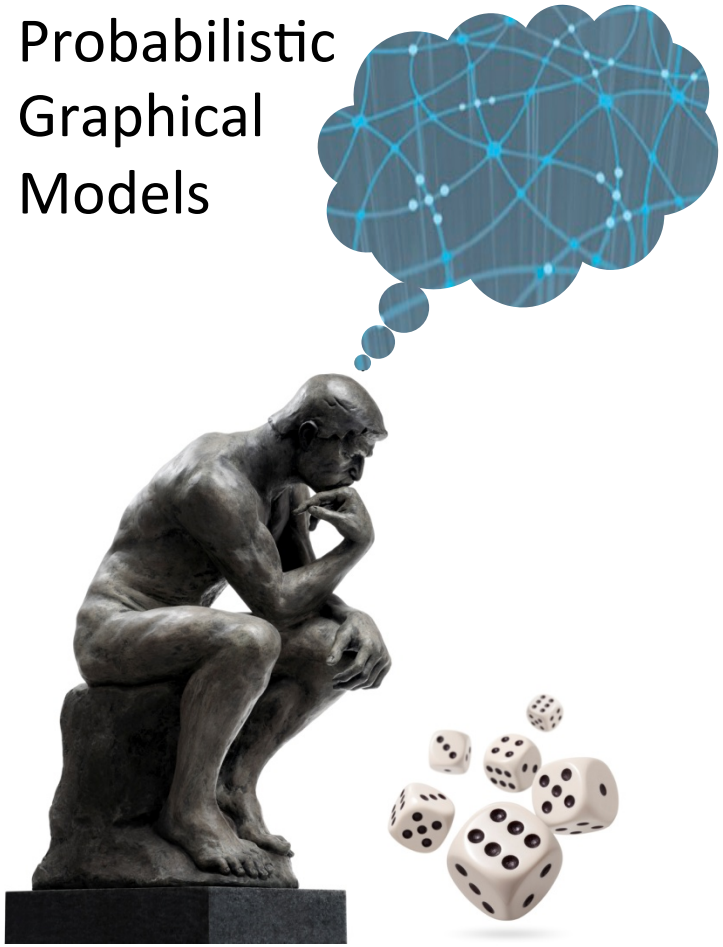
Probabilistic Graphical Models

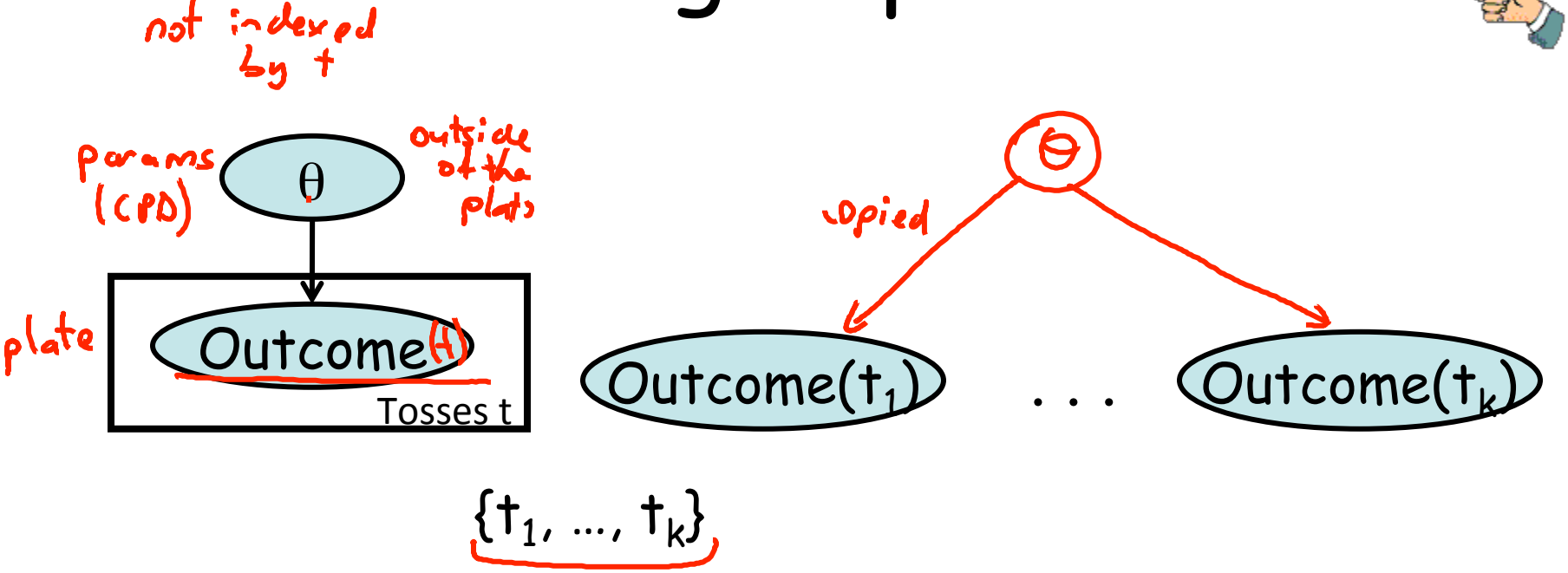


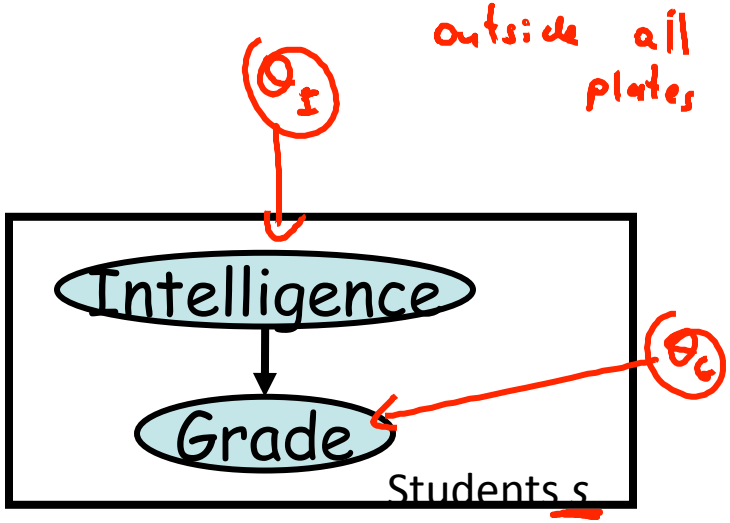
Representation

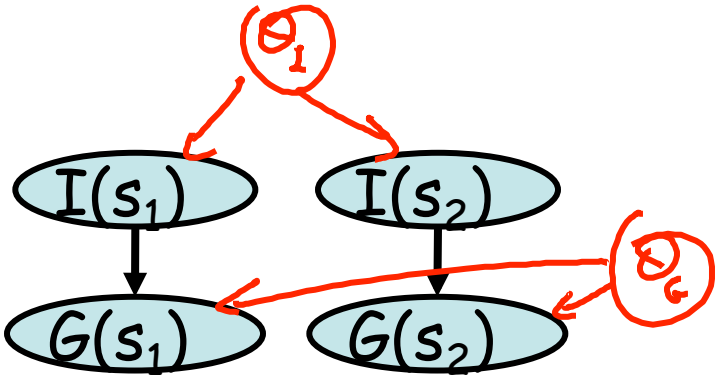
Template Models

Plate Models

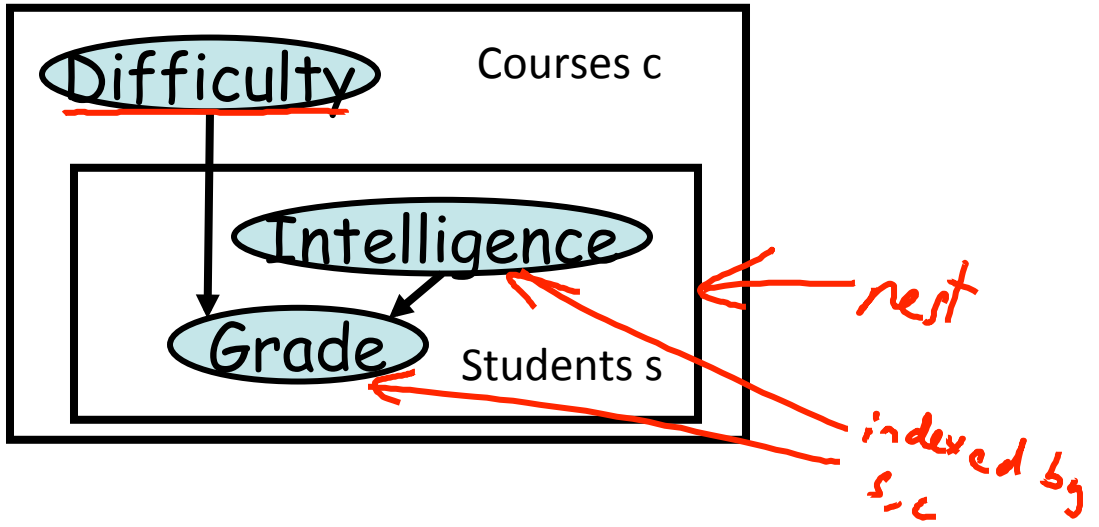
Modeling Repetition

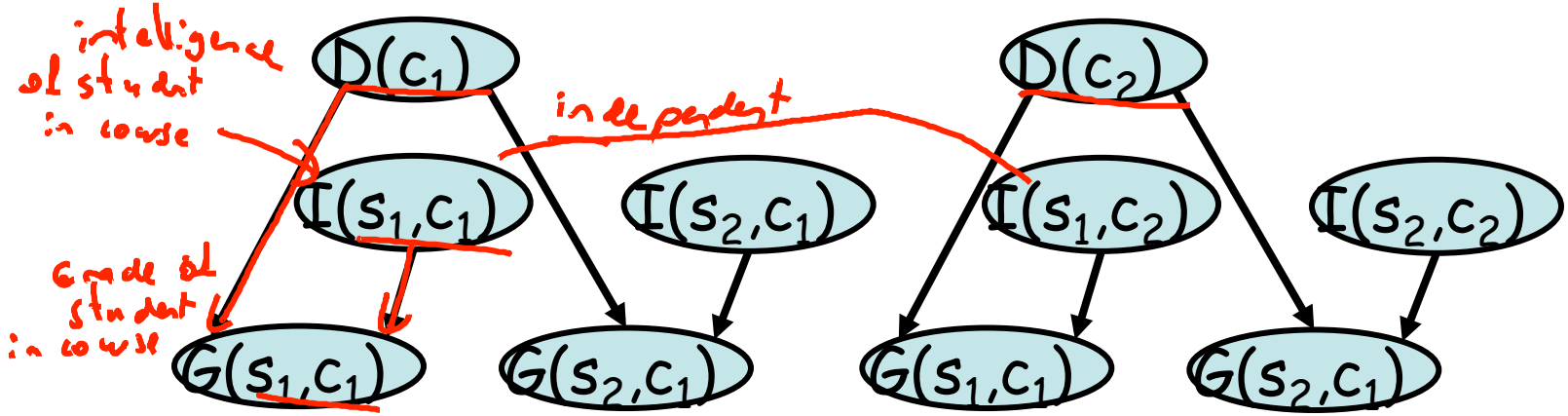



outside all plates
Intelligence
Grade
Students s

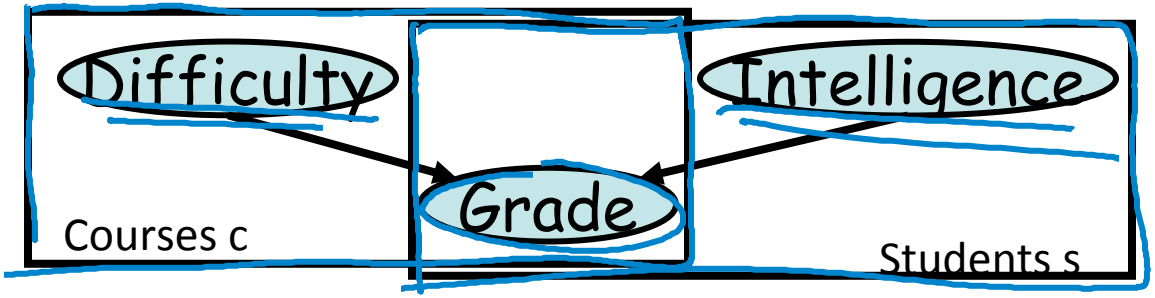

I(s1)
I(s2)
G(s1)
G(s2)

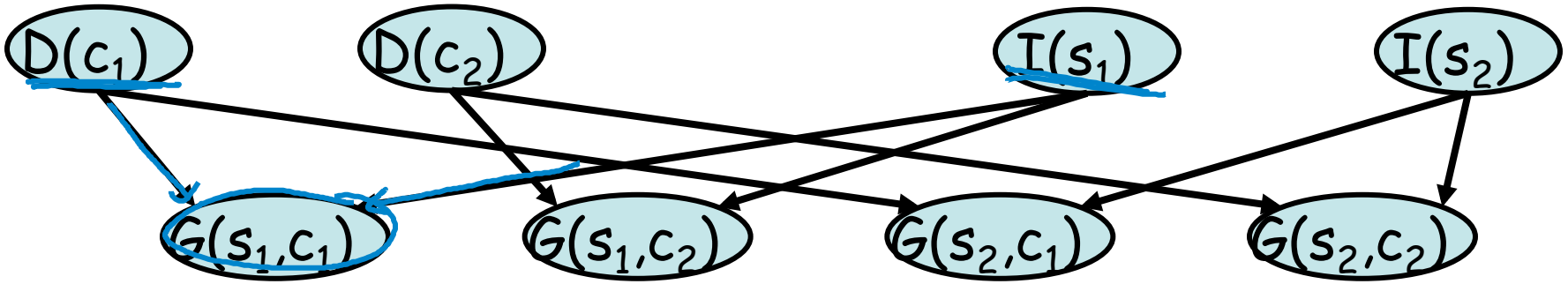
Nested Plates



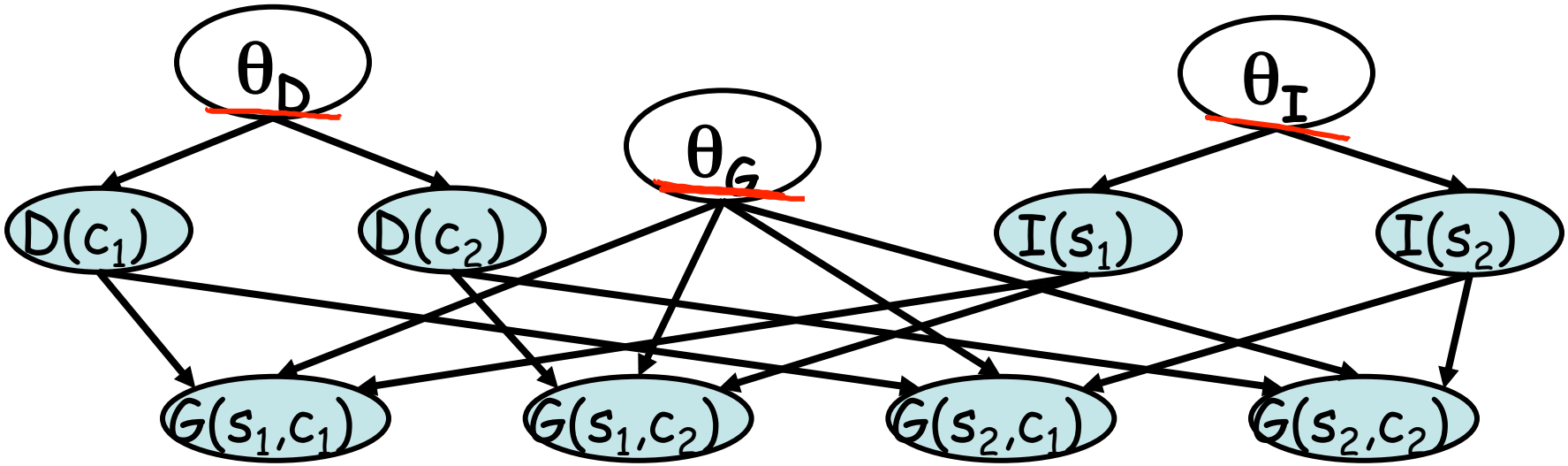


Overlapping Plates

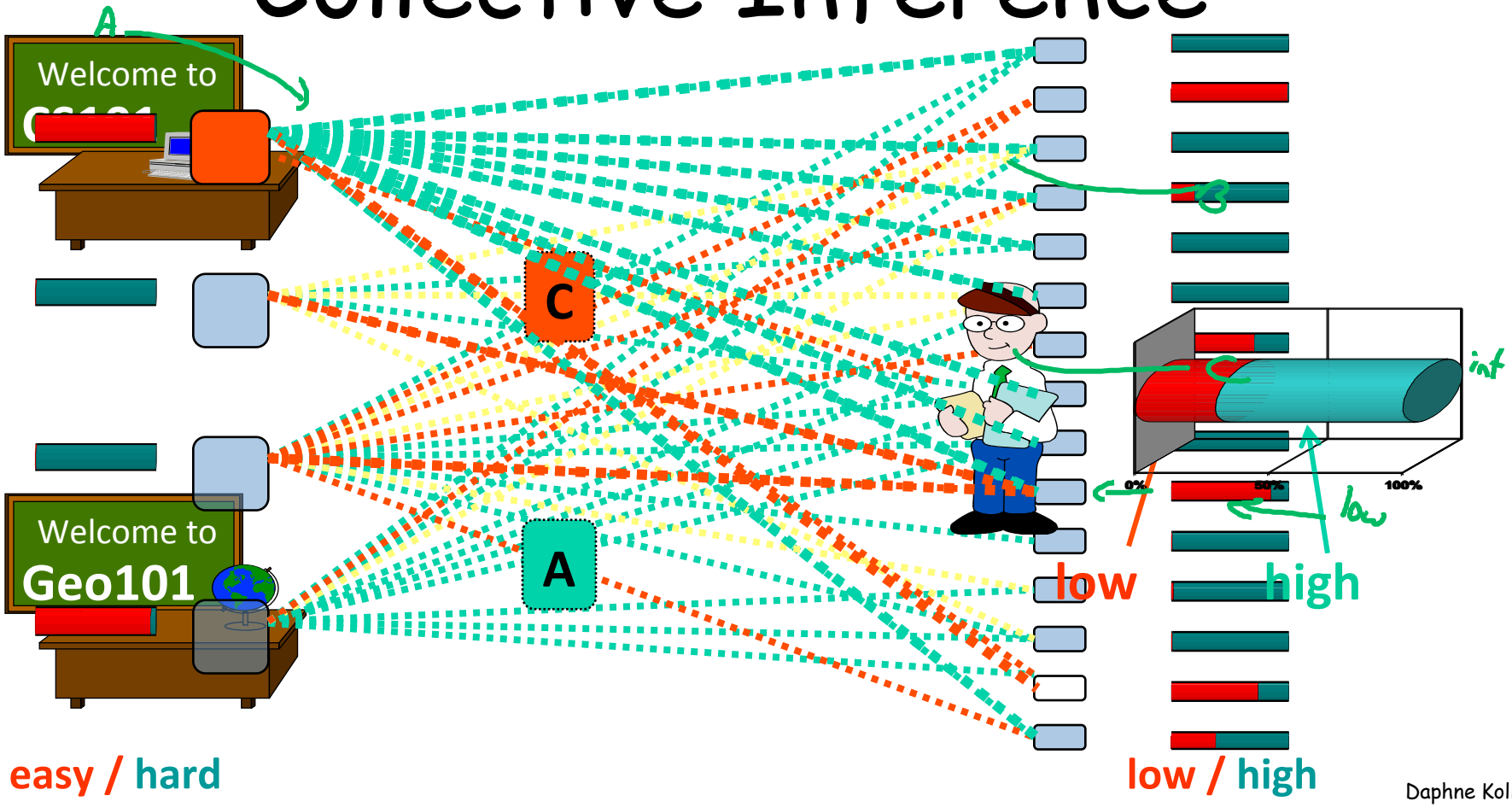




Explicit Parameter Sharing



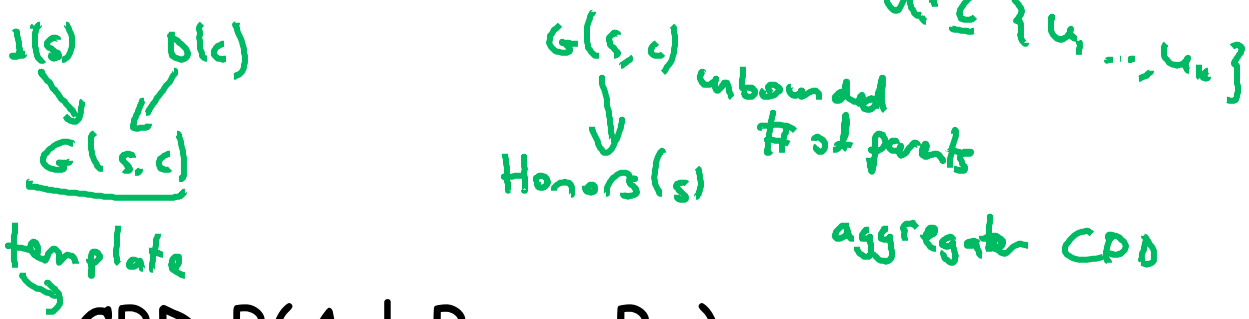
Collective Inference



Daphne Koller

Plate Dependency Model

- For a template variable $A(U_1,\ldots,U_k)$:
  - Template parents $B_1(U_1),\ldots,B_m(U_m)$
  - CPD $P(A \mid B_1,\ldots, B_m)$



Ground Network

Let $A(U_1,\ldots,U_k)$ with parents $B_1(U_1),\ldots,B_m(U_m)$

- for any instantiation $u_1,\ldots,u_k$ to $U_1,\ldots,U_k$ we would have:

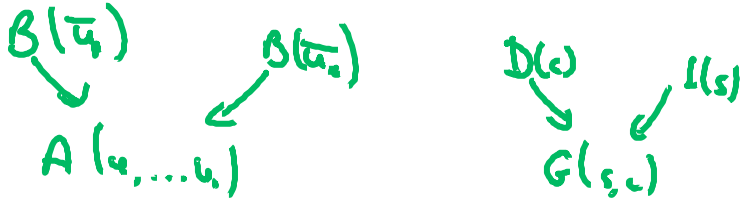
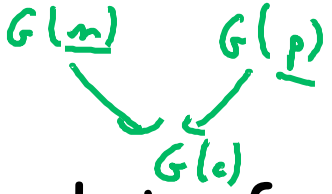


Plate Dependency Model

Let $A(U_1,\ldots,U_k)$ with parents $B_1(\mathbf{U}_1),\ldots,B_m(\mathbf{U}_m)$

- For each i, we must have $\mathbf{U}_i \subseteq U_1,\ldots,U_k$
  - No indices in parent that are not in child



Summary

- Template for an infinite set of BNs, each induced by a different set of domain objects
- Parameters and structure are reused within a BN and across different BNs
- Models encode correlations across multiple objects, allowing collective inference
- Multiple "languages", each with different tradeoffs in expressive power