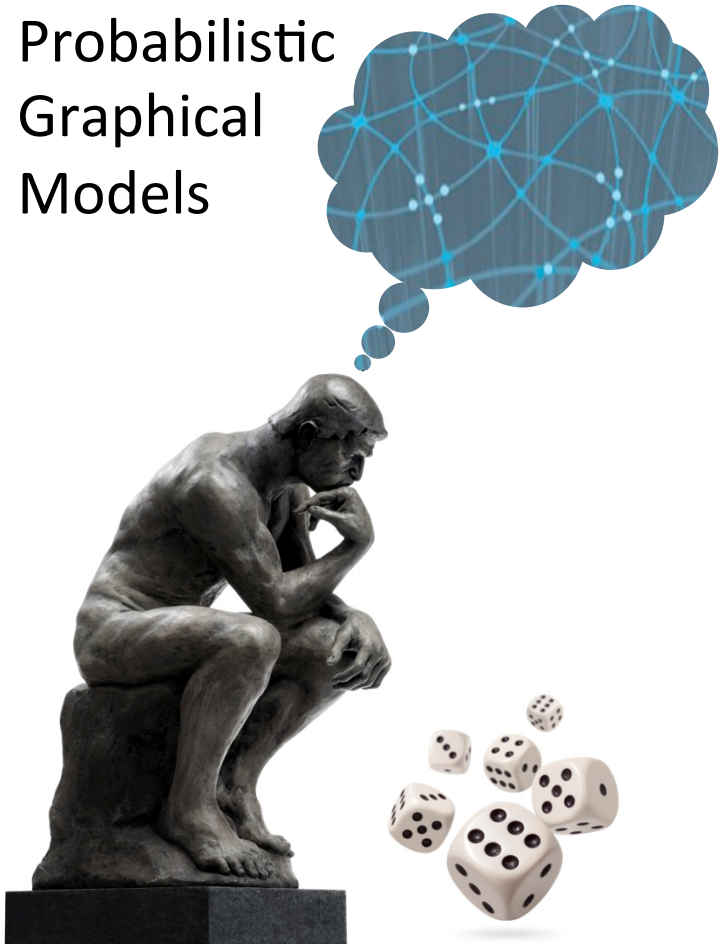
Probabilistic Graphical Models

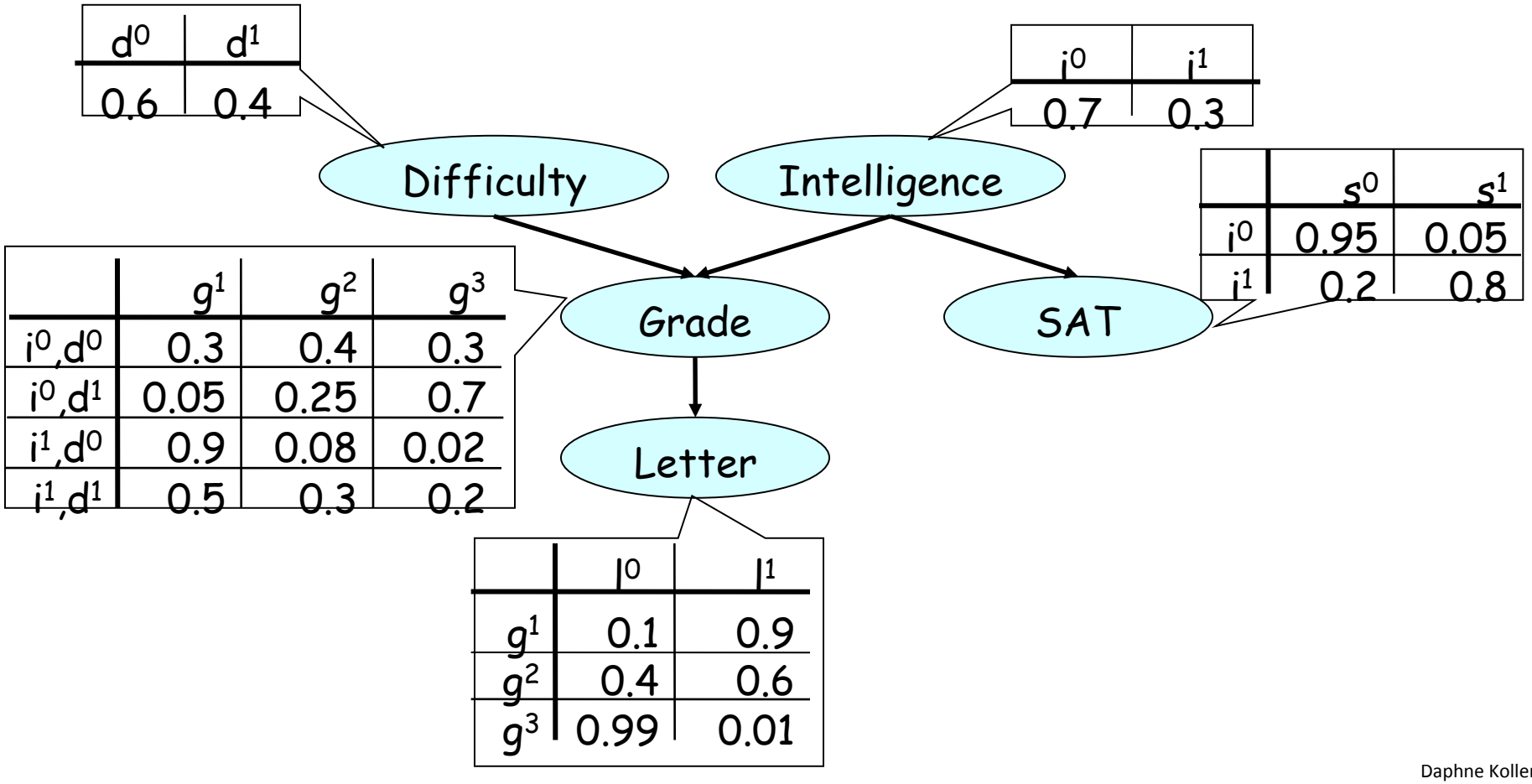


Representation

Bayesian Networks

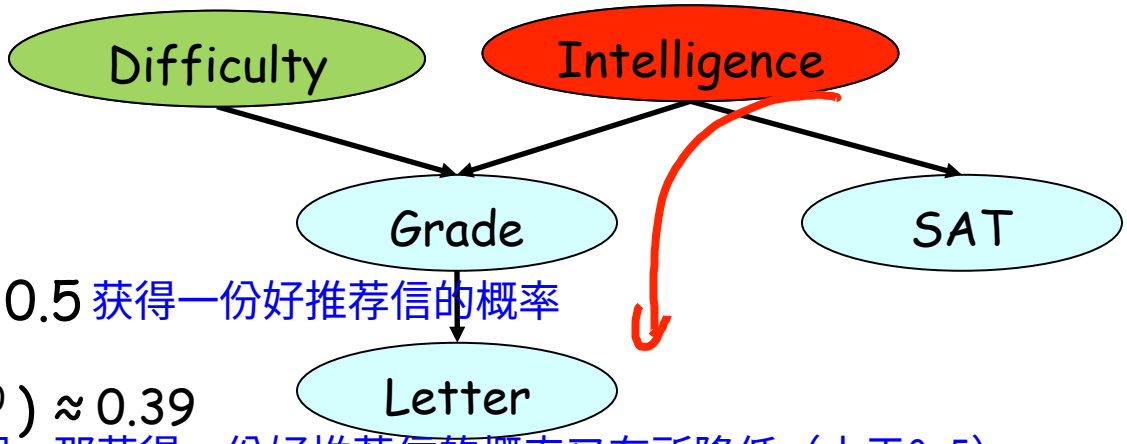
Reasoning Patterns

The Student Network



Causal Reasoning

因果推理



已知 $P(l^1) \approx 0.5$ 获得一份好推荐信的概率

推论1 $P(l^1 \mid i^0) \approx 0.39$

i0表示不太聪明，那获得一份好推荐信的概率又有所降低（小于0.5）

推论2 $P(l^1 \mid i^0, d^0) \approx 0.51$

虽然不太聪明，但课程很简单d0，所以获得教该课程教授的推荐信概率又增加了一些（大于0.5）

Daphne Koller

证据推理

Evidential Reasoning

课程是一门难课程的概率为0.4

已知1 $P(d^1) = 0.4$

推论1 $P(d^1 \mid g^3) \approx 0.63$

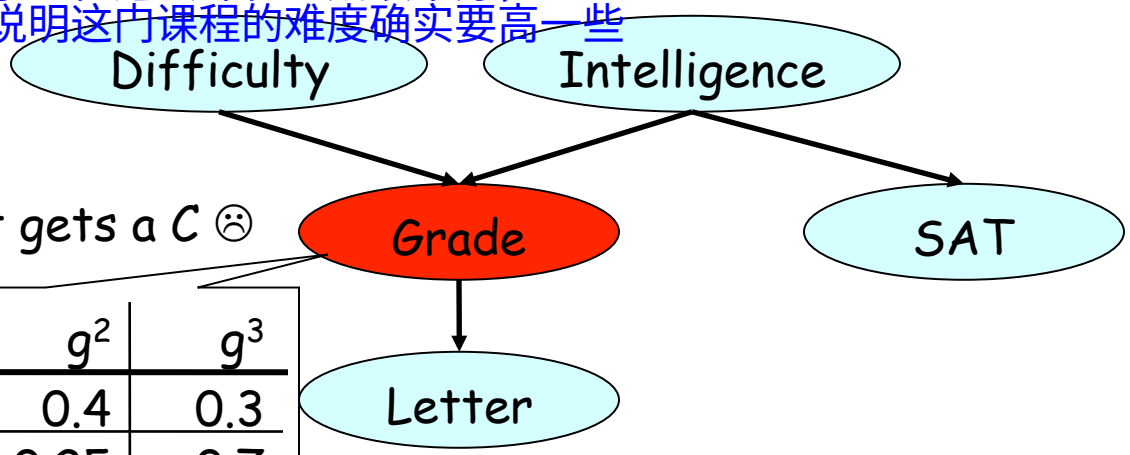
已知2 $P(i^1) = 0.3$

某学生有高智商i1的概率为0.3

推论2 $P(i^1 \mid g^3) \approx 0.08$

表示学生的成绩不好，这进一步降低他有高智商的概率

学生在这么课程的成绩不好，
说明这门课程的难度确实要高一些



Student gets a C ☹

	g^1	g^2	g^3
i^0,d^0	0.3	0.4	0.3
i^0,d^1	0.05	0.25	0.7
i^1,d^0	0.9	0.08	0.02
i^1,d^1	0.5	0.3	0.2

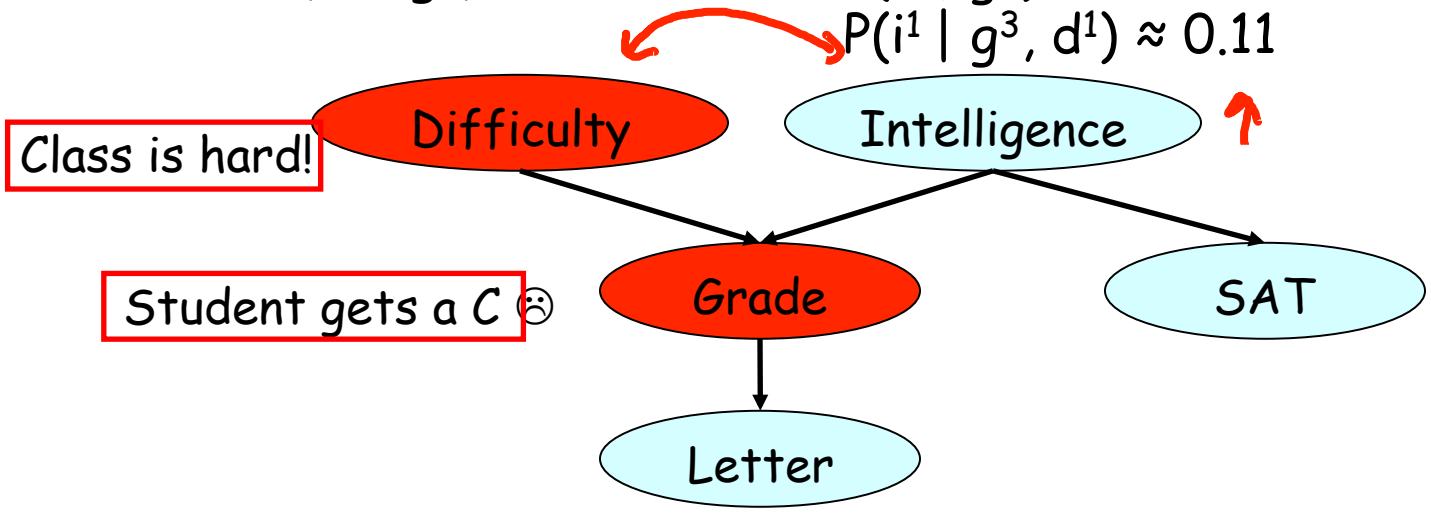
逆着有向图箭头方向推理

因果间推理

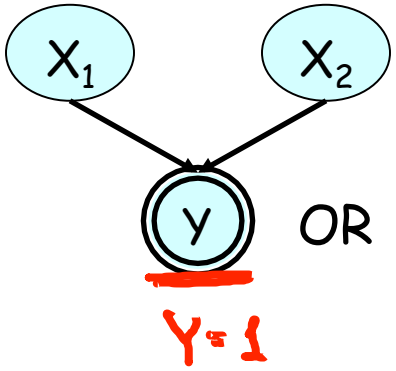
Intercausal Reasoning

$P(d^1) = 0.4$
$P(d^1 \mid g^3) \approx 0.63$

$P(i^1) = 0.3$
$P(i^1 \mid g^3) \approx 0.08$
$P(i^1 \mid g^3, d^1) \approx 0.11$



Intercausal Reasoning Explained



explaining away

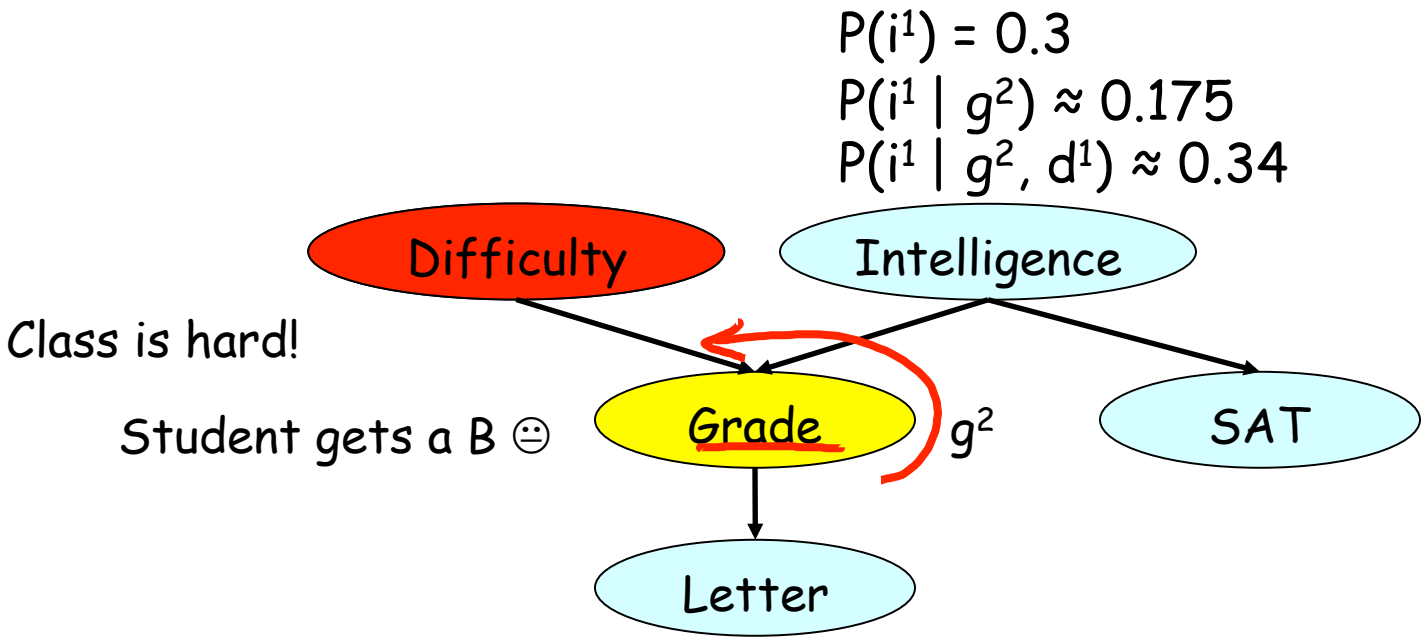
X_1	X_2	Y	Prob
0	0	0	0.25
0	1	1	0.25
1	0	1	0.25
1	1	1	0.25

0.33
0.33
0.33

$P(X_1=1) = \frac{2}{3}$ $P(X_2=1) = \frac{2}{3}$

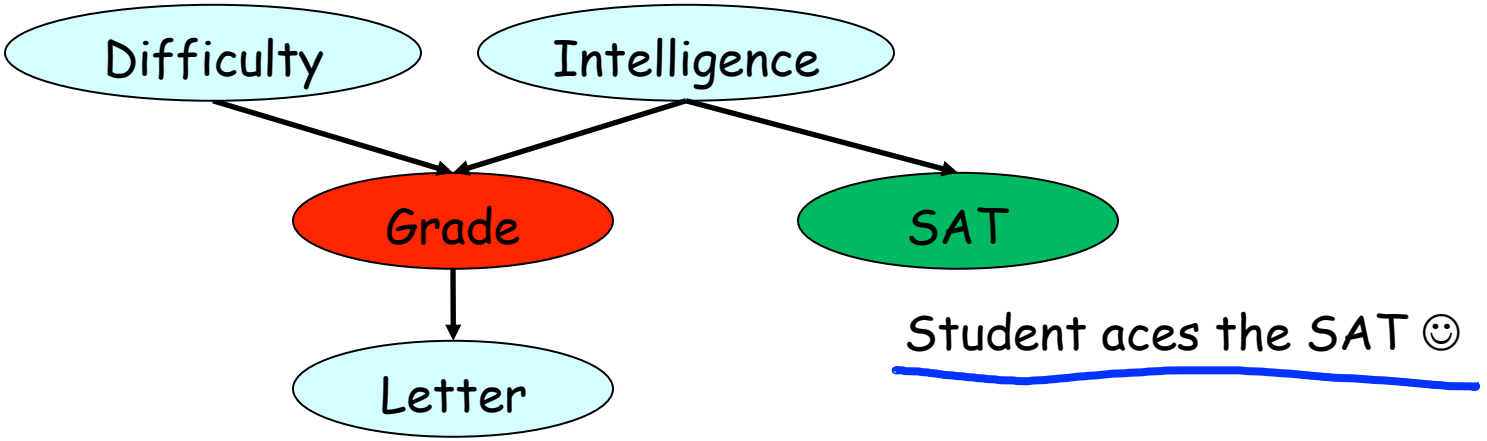
conditional $P(X_2=1 \mid X_1=1) = 0.5$

Intercausal Reasoning II



Student Aces the SAT

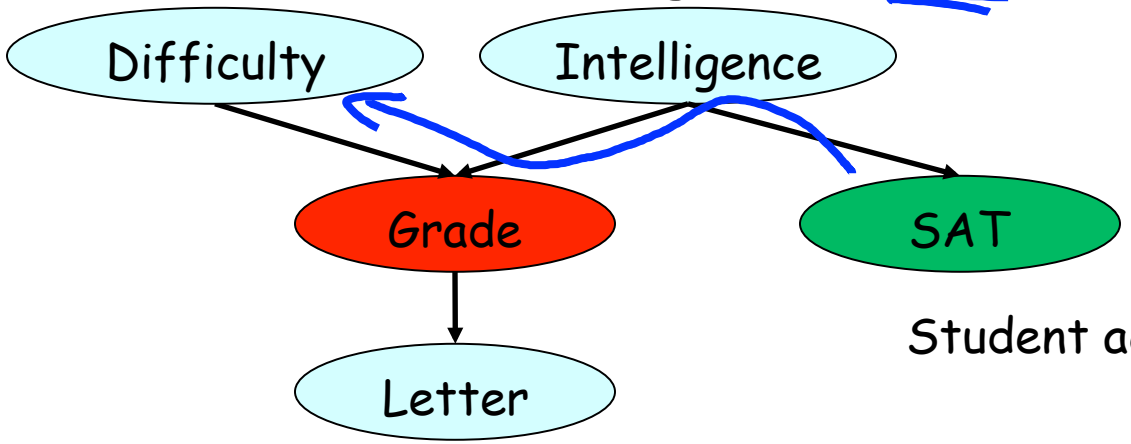
- What happens to the posterior probability that the class is hard?



Student Aces the SAT

$P(d^1) = 0.4$
$P(d^1 \mid g^3) \approx 0.63$
$P(d^1 \mid g^3, s^1) \approx 0.76$

$P(i^1) = 0.3$
$P(i^1 \mid g^3) \approx 0.08$
$P(i^1 \mid g^3, s^1) \approx 0.58$



Student aces the SAT ☺

Student gets a C ☹