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Reintroducing Credal Networks under Epistemic Irrelevance

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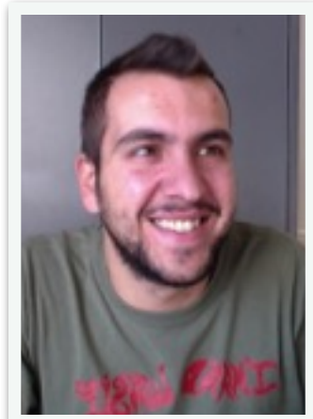

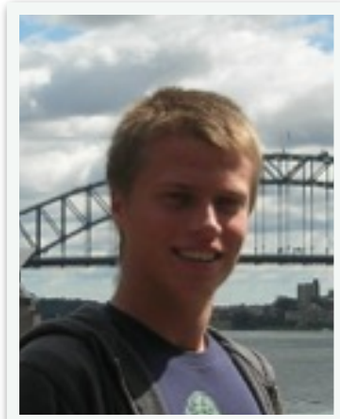

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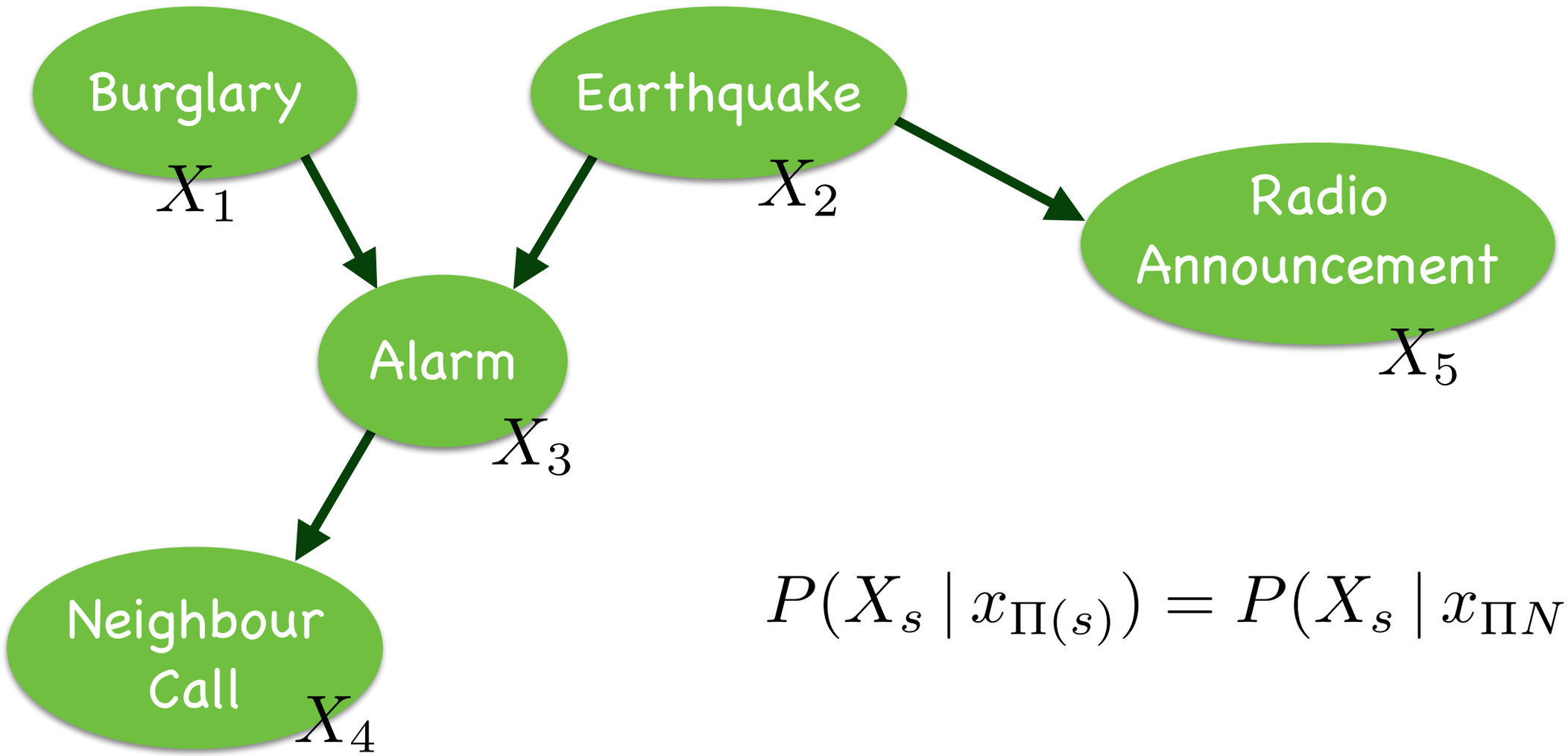
Reintroducing Credal Networks under Epistemic Irrelevance

Bayesian network

$$P(x_G) = \prod_{s \in G} P(x_s \mid x_{\Pi(s)})$$

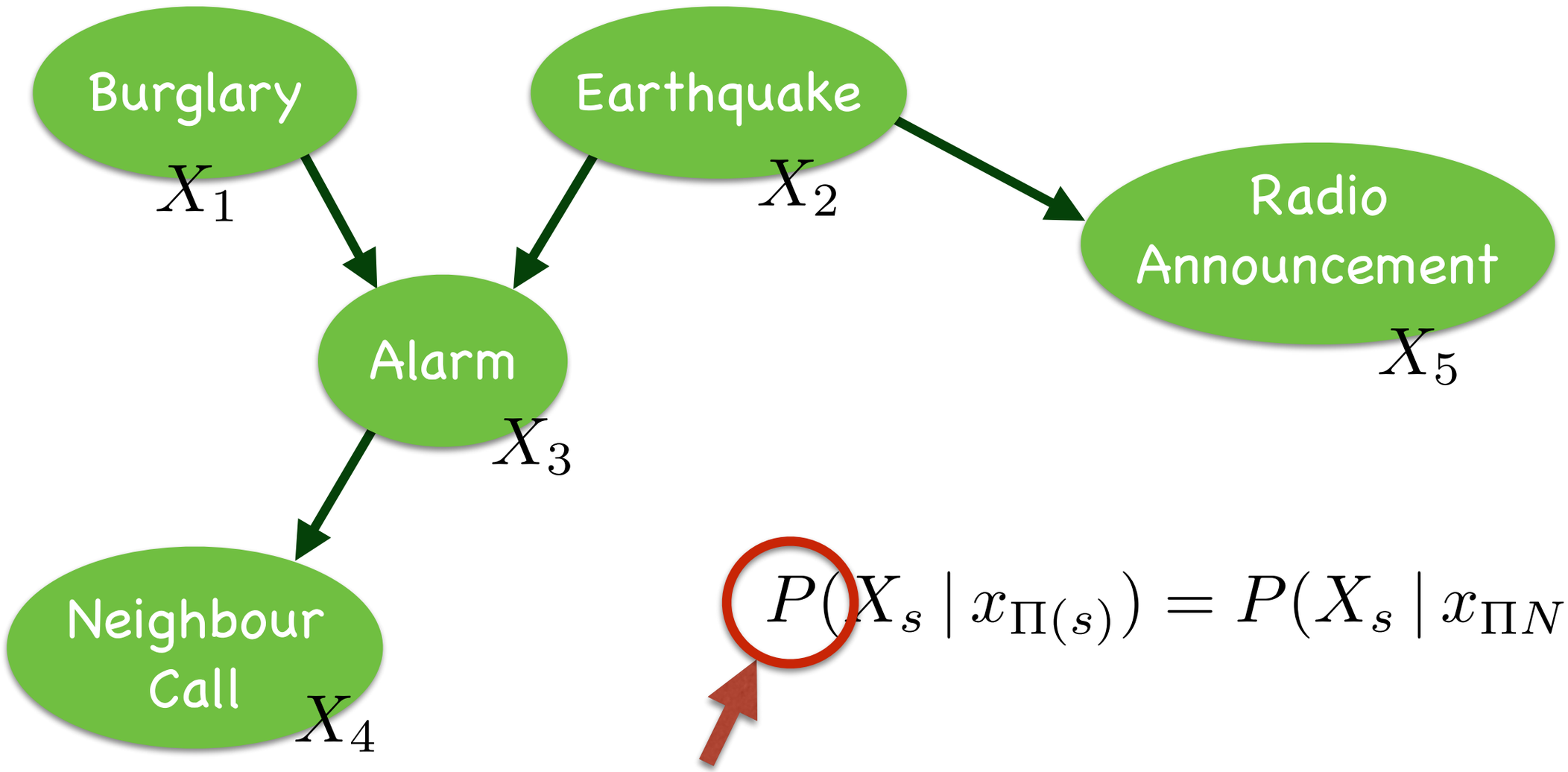


$$P(X_s \mid x_{\Pi(s)}) = P(X_s \mid x_{\Pi N(s)})$$

extreme sensitivity analysis ?

Bayesian network

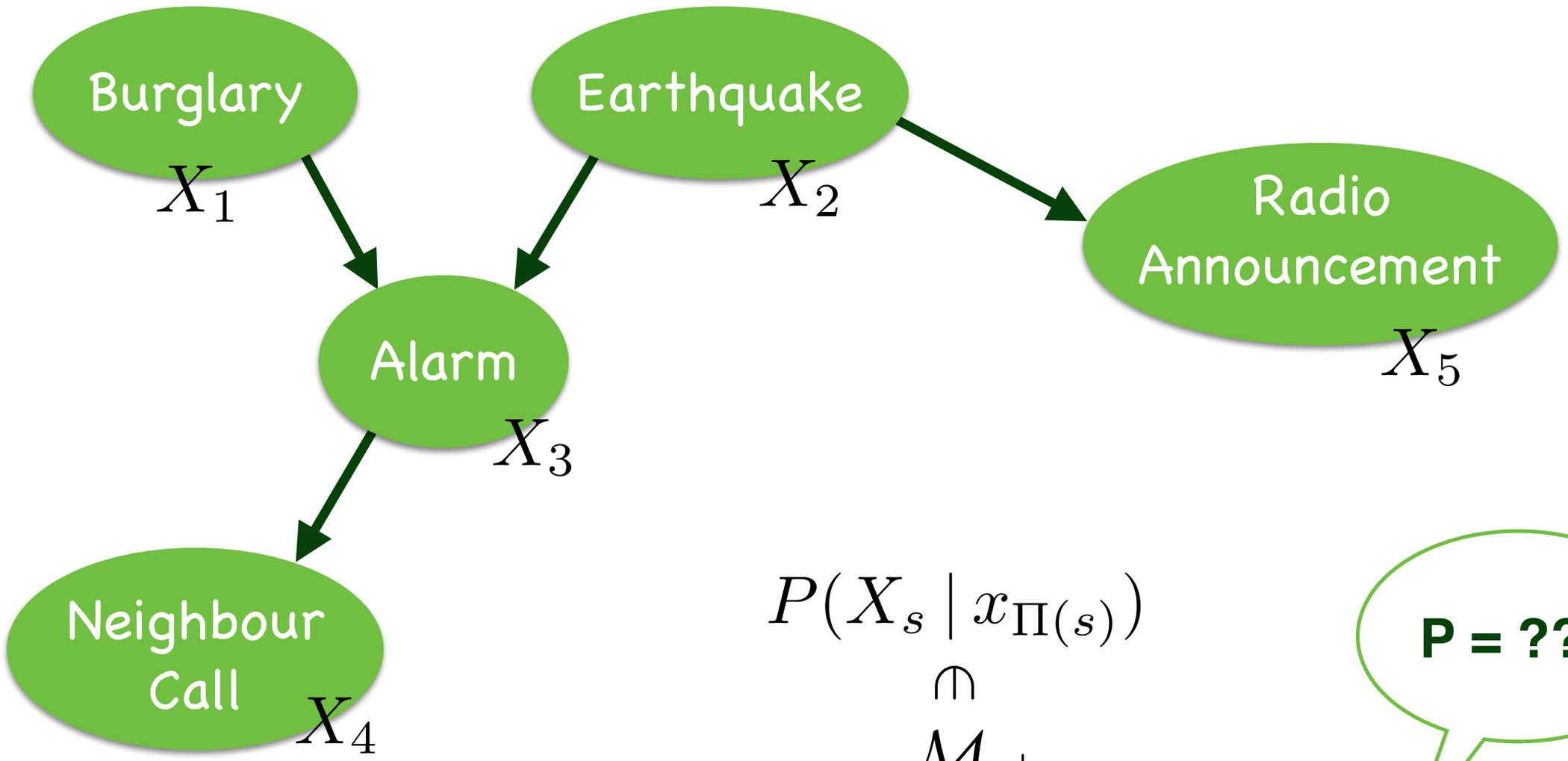
$$P(x_G) = \prod_{s \in G} P(x_s \mid x_{\Pi(s)})$$



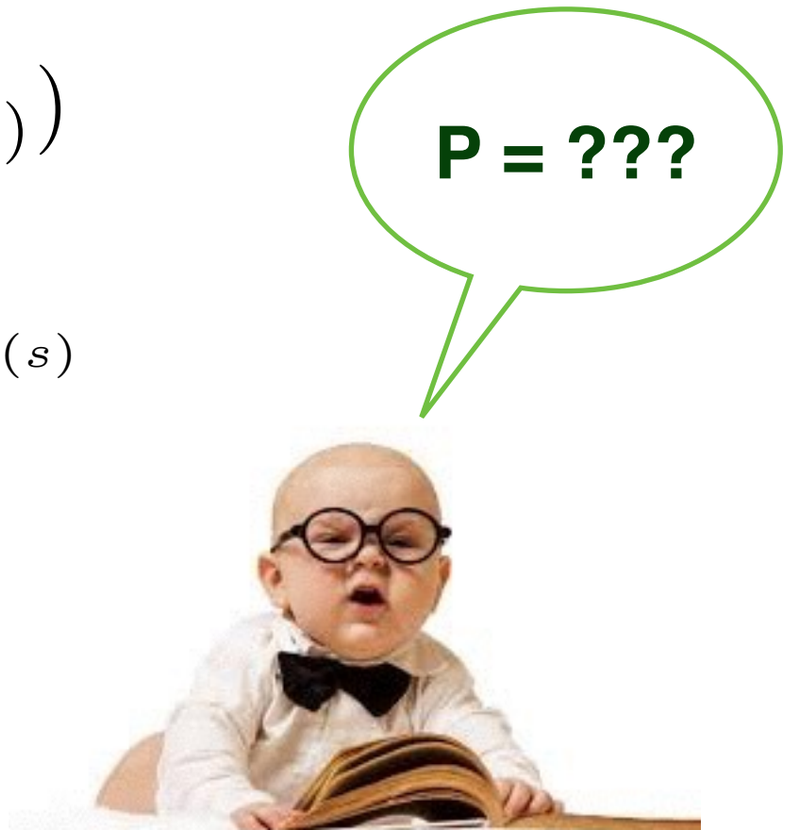
$$P(X_s \mid x_{\Pi(s)}) = P(X_s \mid x_{\Pi N(s)})$$

extreme sensitivity analysis ?

Credal network…

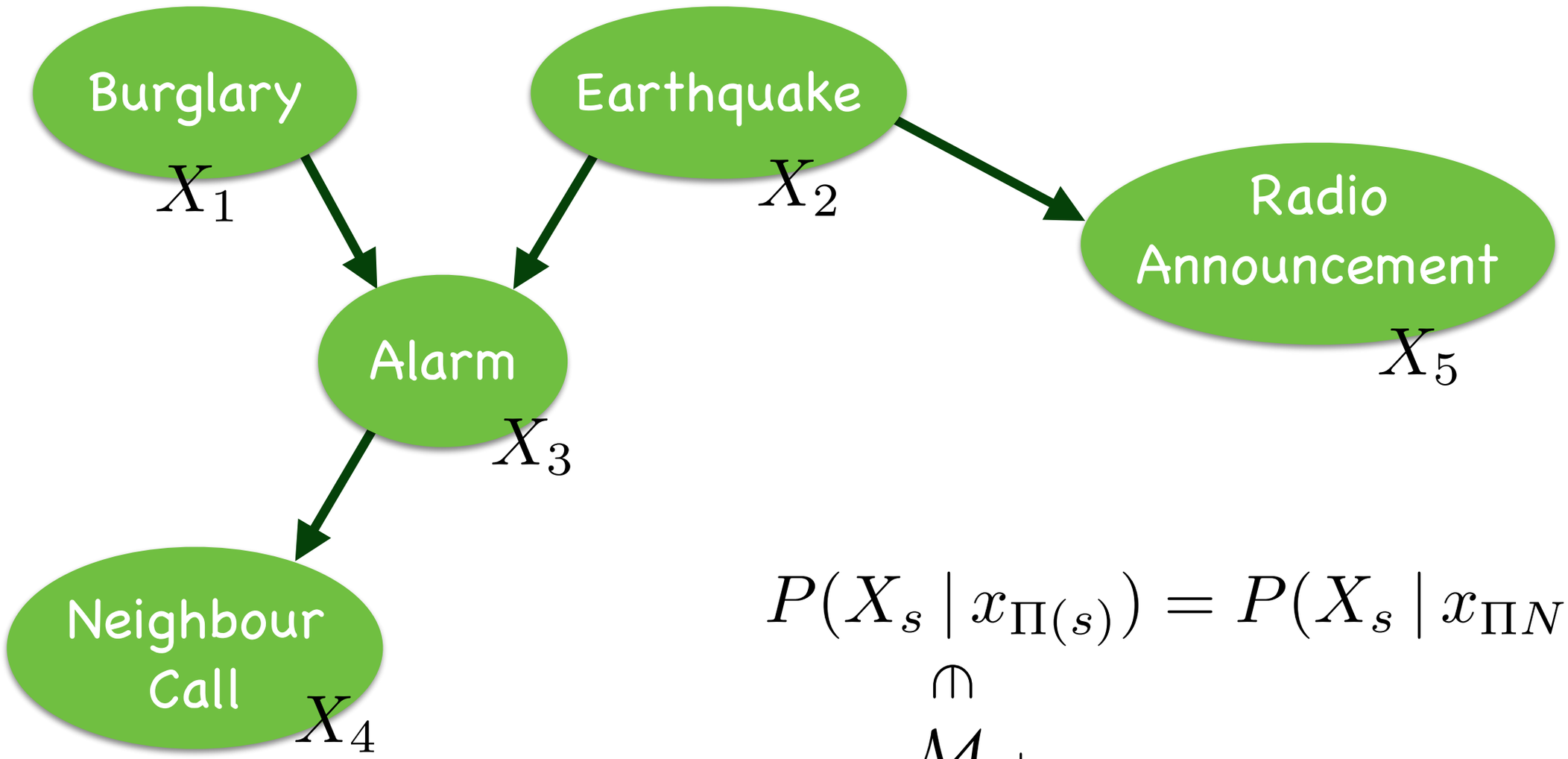


$$P(X_s \mid x_{\Pi(s)}) \in \mathcal{M}_{s|x_{\Pi(s)}}$$



Credal network…

$$P(x_G) = \prod_{s \in G} P(x_s \mid x_{\Pi(s)})$$



$$P(X_s \mid x_{\Pi(s)}) = P(X_s \mid x_{\Pi N(s)})$$

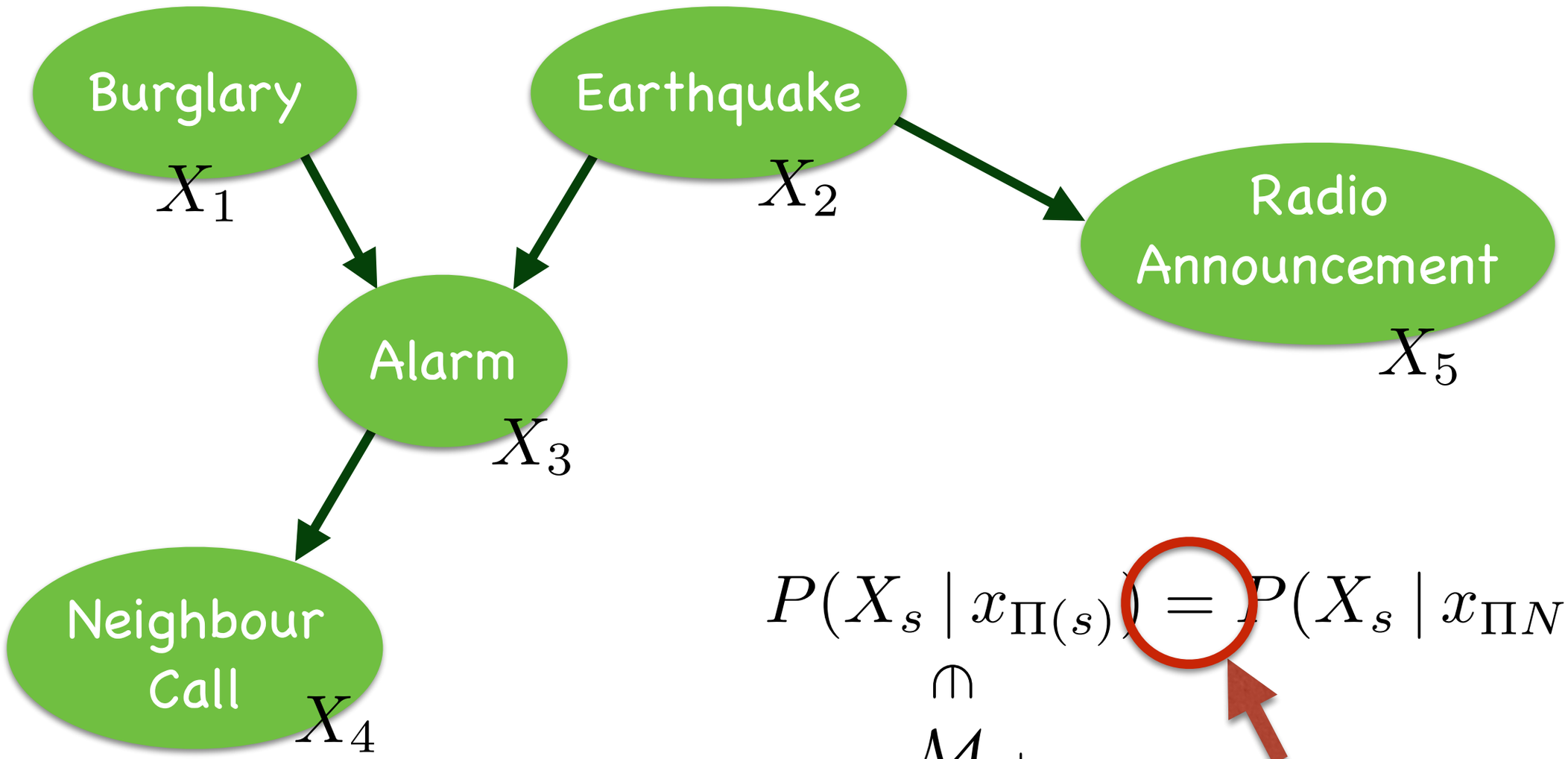
$$\Cap$$

$$\mathcal{M}_{s|x_{\Pi(s)}}$$

…under complete independence

Credal network…

$$P(x_G) = \prod_{s \in G} P(x_s \mid x_{\Pi(s)})$$



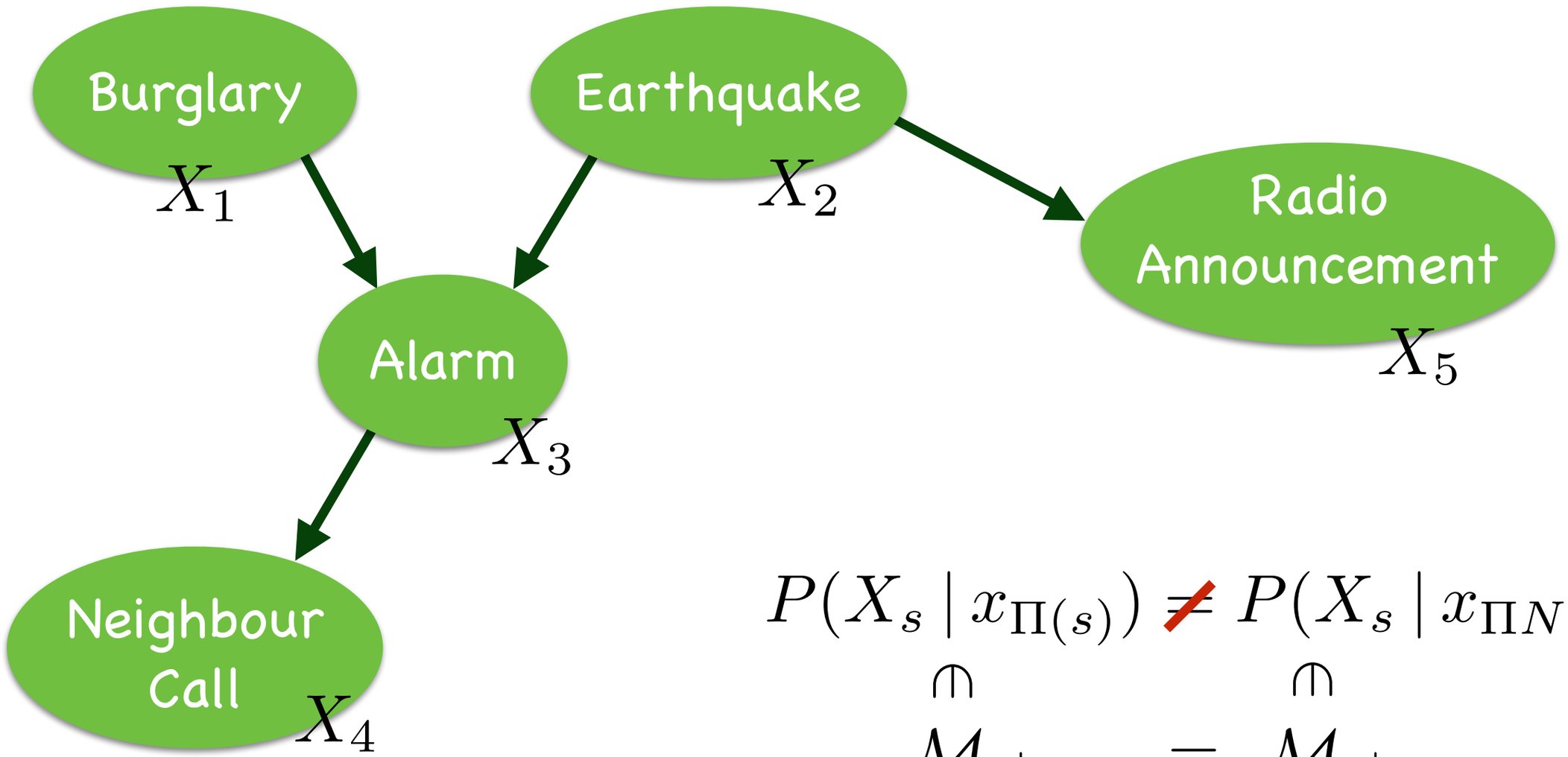
$$P(X_s \mid x_{\Pi(s)}) = P(X_s \mid x_{\Pi N(s)})$$

$$\Updownarrow$$

$$\mathcal{M}_{s|x_{\Pi(s)}}$$

…under complete independence

Credal network…



$$P(X_s \mid x_{\Pi(s)}) \neq P(X_s \mid x_{\Pi N(s)})$$

$$\cap \qquad\qquad \cap$$

$$\mathcal{M}_{s|x_{\Pi(s)}} = \mathcal{M}_{s|x_{\Pi N(s)}}$$

…under epistemic irrelevance

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Before

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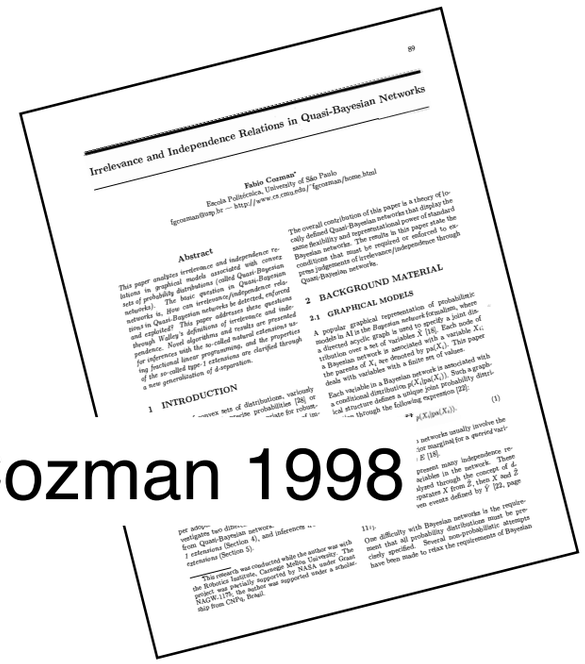
Reintroducing Credal Networks under Epistemic Irrelevance



Irrelevance and Independence Relations in Quasi-Bayesian Networks

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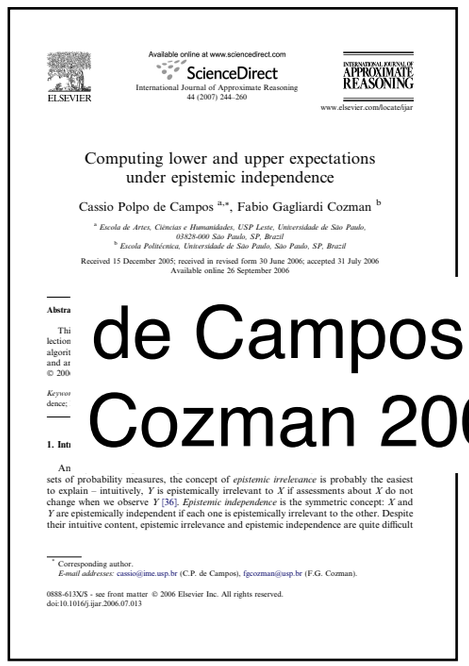
Abstract

This paper analyzes irrelevance and independence relations in graphical models associated with convex sets of probability distributions (called Quasi-Bayesian networks). How can irrelevance/independence be detected, enforced and exploited? This paper addresses these questions in Quasi-Bayesian networks that rely on Walley's definitions of irrelevance and independence. Novel algorithms and results are presented for inferences with so-called natural extensions via fractional linear programming, and the properties of the so-called type 1 extensions are clarified through a new generalization of d-separation.

1 INTRODUCTION

Cozman 1998



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International Journal of Approximate Reasoning 44 (2007) 244–260

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Computing lower and upper expectations under epistemic independence

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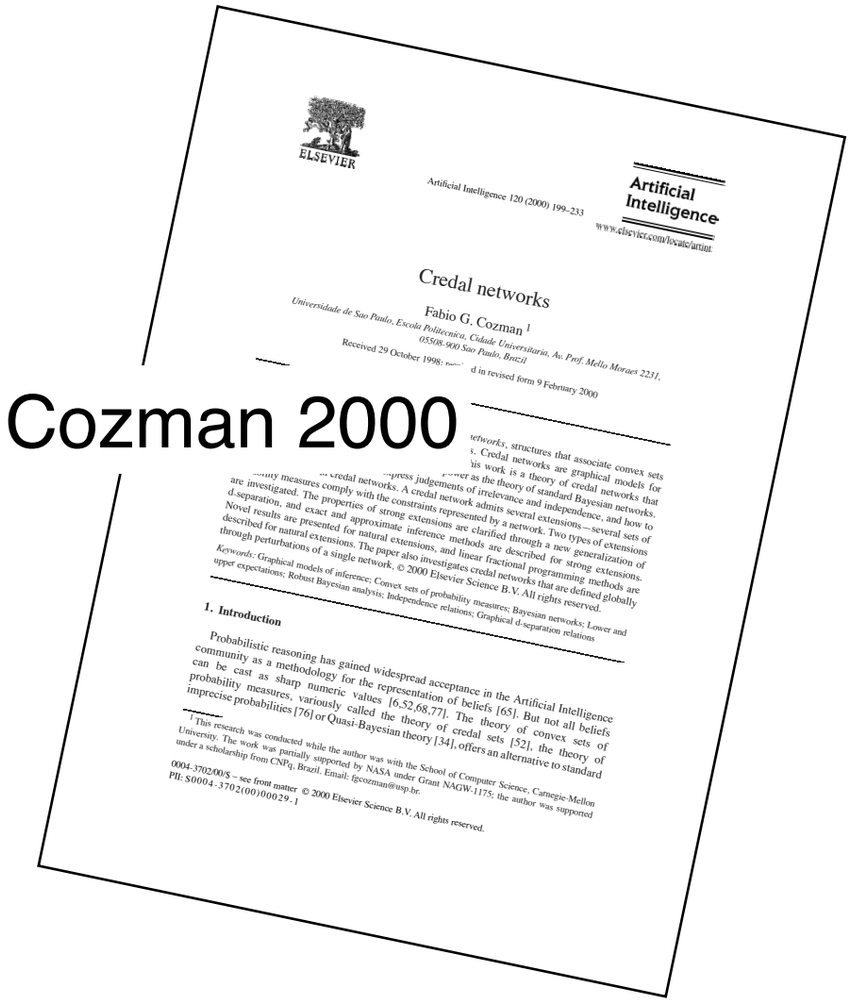
Received 15 December 2005; received in revised form 30 June 2006; accepted 31 July 2006

Available online 26 September 2006

de Campos & Cozman 2007



Artificial Intelligence 120 (2000) 199–233

Artificial Intelligence

www.elsevier.com/locate/artint

Credal networks

Fabio G. Cozman [1]

Universidade de São Paulo, Escola Politécnica, Cidade Universitária, Av. Prof. Mello Moraes 2231, 05508-900 São Paulo, Brazil

Cozman 2000

Before

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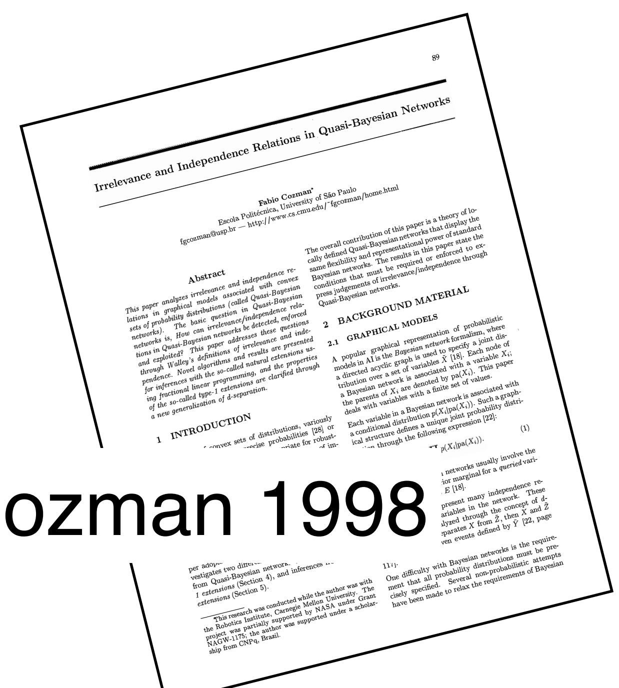
d-separation?

$$P(x_G) = \prod_{s \in G} P(x_s \mid x_{\Pi(s)})$$

efficient computations?

Reintroducing

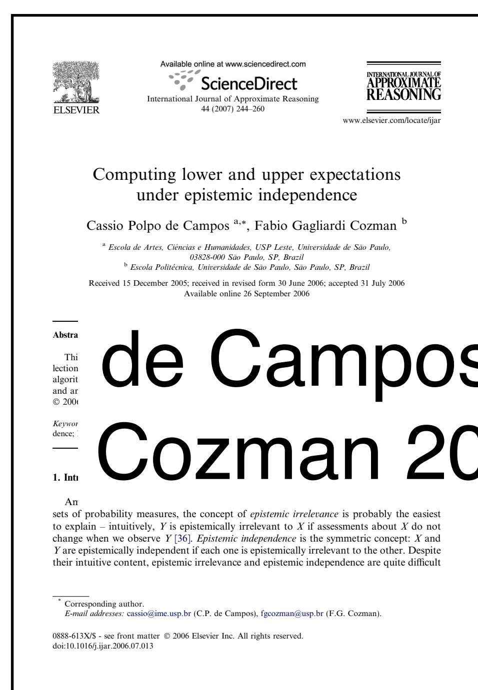
Credal Networks under Epistemic Irrelevance



Irrelevance and Independence Relations in Quasi-Bayesian Networks

Fabio Cozman

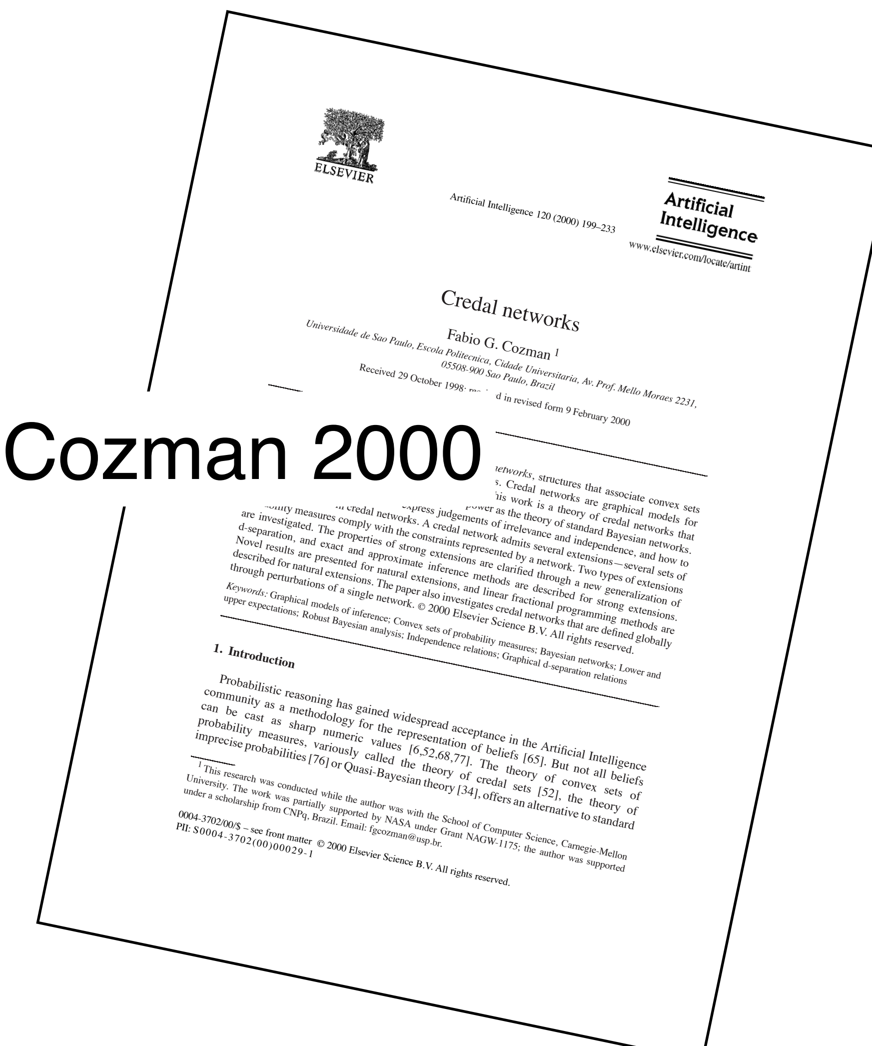
Cozman 1998



Computing lower and upper expectations under epistemic independence

Cassio Polpo de Campos, Fabio Gagliardi Cozman

de Campos & Cozman 2007



Credal networks

Fabio G. Cozman

Cozman 2000

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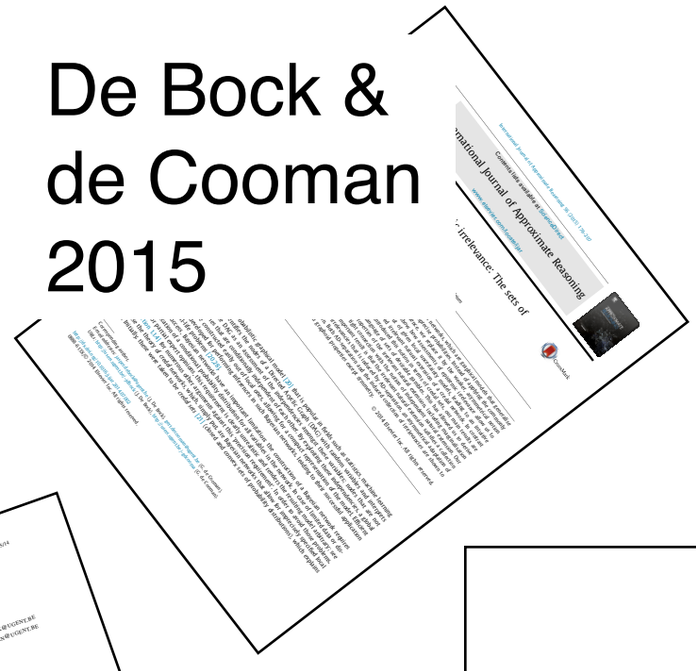
AD-separation ✓

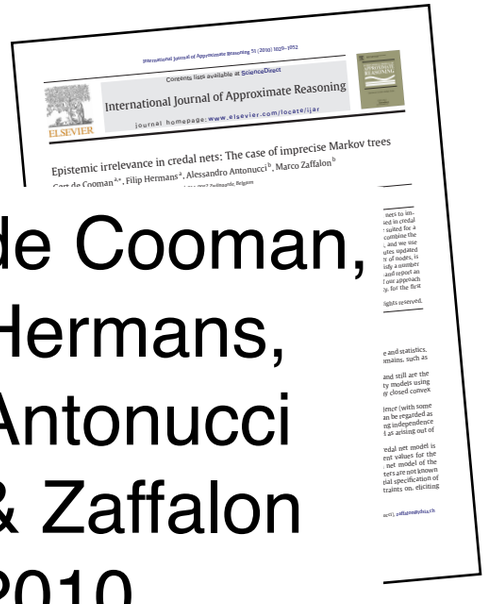
$$P(x_G) = \prod_{s \in G} P(x_s \mid x_{\Pi(s)})$$

efficient computations ✓

Reintroducing Credal Networks under Epistemic Irrelevance

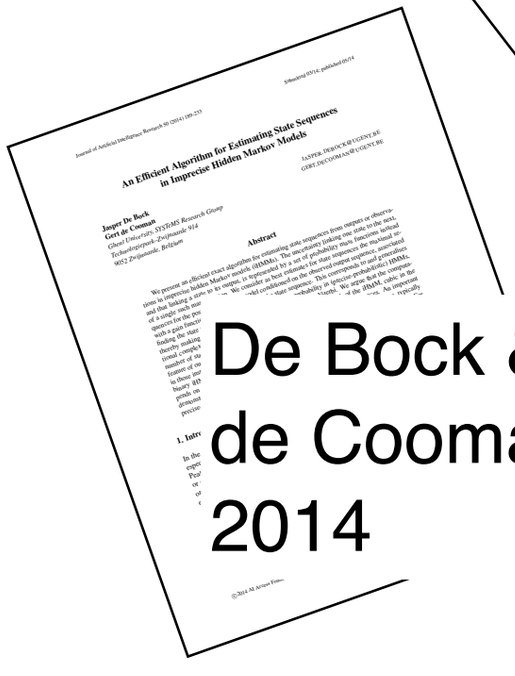


De Bock & de Cooman 2015

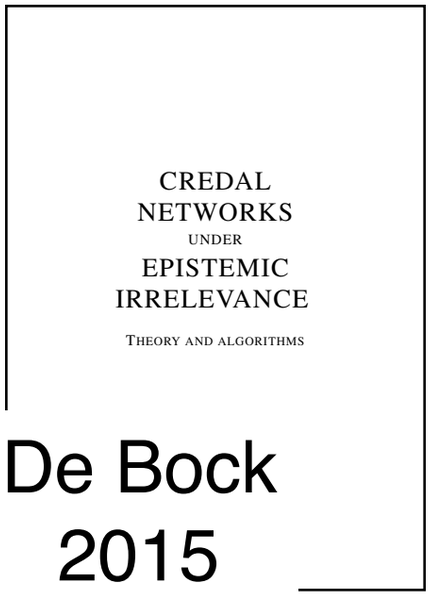


de Cooman, Hermans, Antonucci & Zaffalon 2010

Benavoli, Zaffalon & Miranda 2011



De Bock & de Cooman 2014



De Bock 2015

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Reintroducing Credal Networks under Epistemic Irrelevance

AD-separation ✓

$$P(x_G) = \prod_{s \in G} P(x_s \mid x_{\Pi(s)})$$

efficient computations ✓

in terms of probabilities !

graphoid properties

II ?

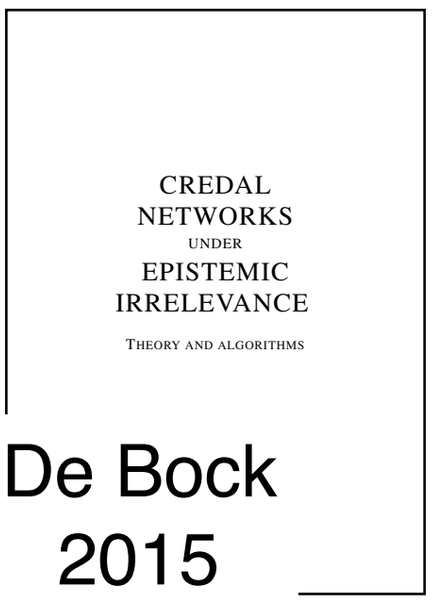
axioms

probability zero?

- full conditional probabilities
- epistemic h-irrelevance

strong independence?

More details + algorithms?



De Bock 2015