Announcement on Moodle

Announcement on Moodle

Announcement on Moodle (Cont.)

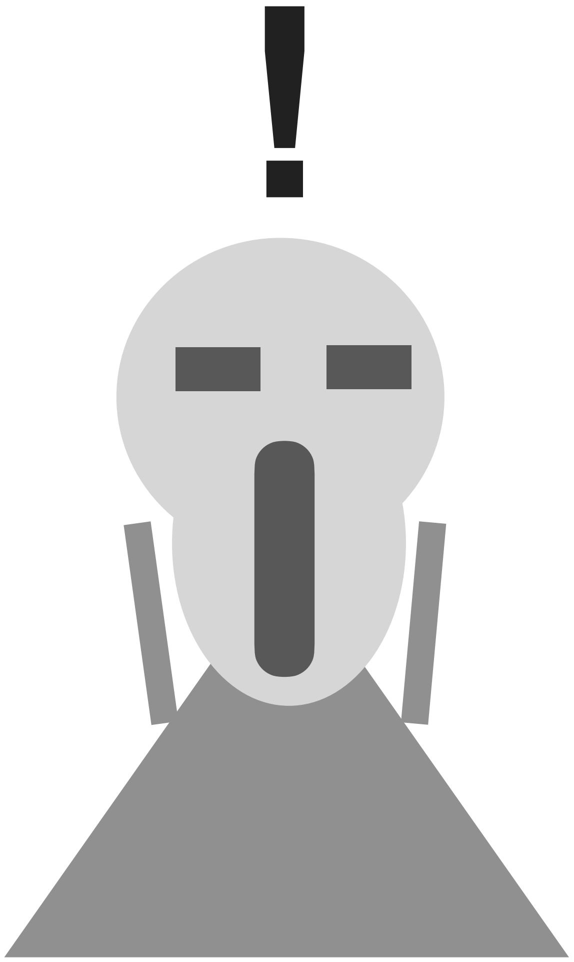
Home 儀表板 事件 我的課程 這個課程

公告 Announcements

一般消息與公告

新增一個主題

議題	開始於
作業回饋	李 逸盛
手寫作業一成績公布與解答	李 逸盛
課程助教	Wei LY
程式作業一: 成績公布	李 逸盛
手寫作業二公布	Wei LY
程式作業一: 線上測試 Python 使用版本	Wei LY
程式作業一: 關於 random-restart 最佳 cost 的廁所位置	Wei LY
台灣 AI 博覽會 - AI EXPO 2024 (自由參加)	Wei LY
程式作業一 ：random-restart 時間限制	李 逸盛
程式作業一: 距離計算簡化	Wei LY
程式作業一 ：random-restart 次數問題	Wei LY



Get Announcement Information by Email

- Moodle: default email setting: Mail2000 (@.nccu.edu.tw)
- Method 1
  - Modify your email address on Moodle
- Method 2
  - Use auto-forwarding in Mail2000
    - ref. https://sites.google.com/g.nccu.edu.tw/gsuite/auto-forward

Method 1

正體中文 (zh_tw)
Wei LY
儀表板
Search Course
瀏覽個人資料
編修個人資料
啟動編輯模式
成績
編修個人資料
偏好
通知
人工智慧概論_I
行事曆
變換角色為...
登出

偏好 › 用戶帳號 › 編修個人資料
Wei LY
一般
姓氏
Wei
名字
LY
電子郵件信箱
lywei@g.nccu.edu.tw

Method 2

政大郵件信箱的信自動轉到Google Workspace

1. 登入mail2000系統 http://nccu.edu.tw/
2. 點選左側的個人設定->信件處理->自動轉寄

4. 如欲保留副本於mail2000系統上，請勾選「保留副本」。

5. 最後請按下「確定」。

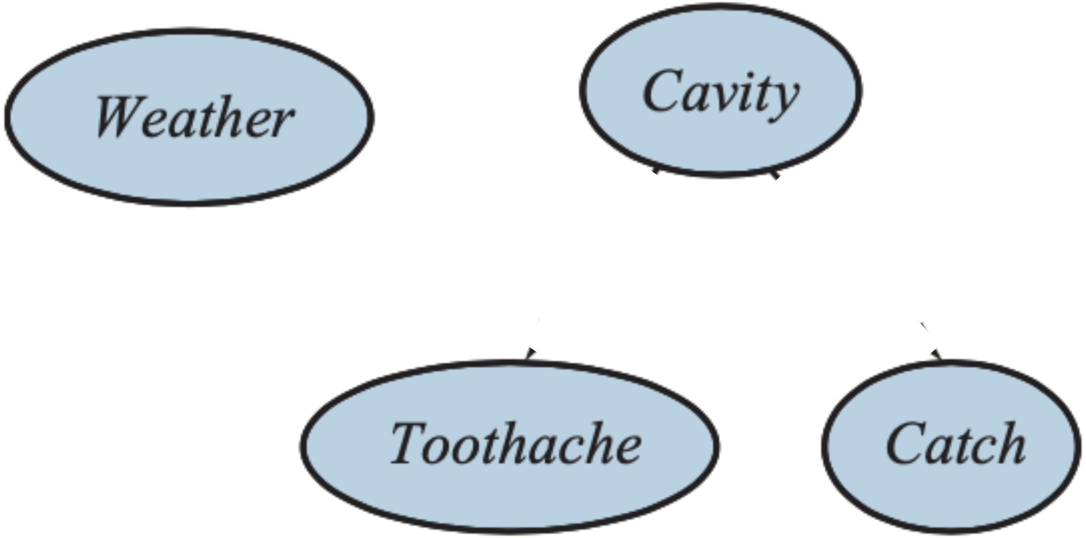
Issue for Full Joint Probability Distribution

- Examples
  - For **3** boolean variables,
    a full joint probability distribution requires $2 \times 2 \times 2 = 2^3 = 8$ numbers
  - For **30** boolean variables,
    a full joint probability distribution requires $\mathbf{2^{30}}$ numbers

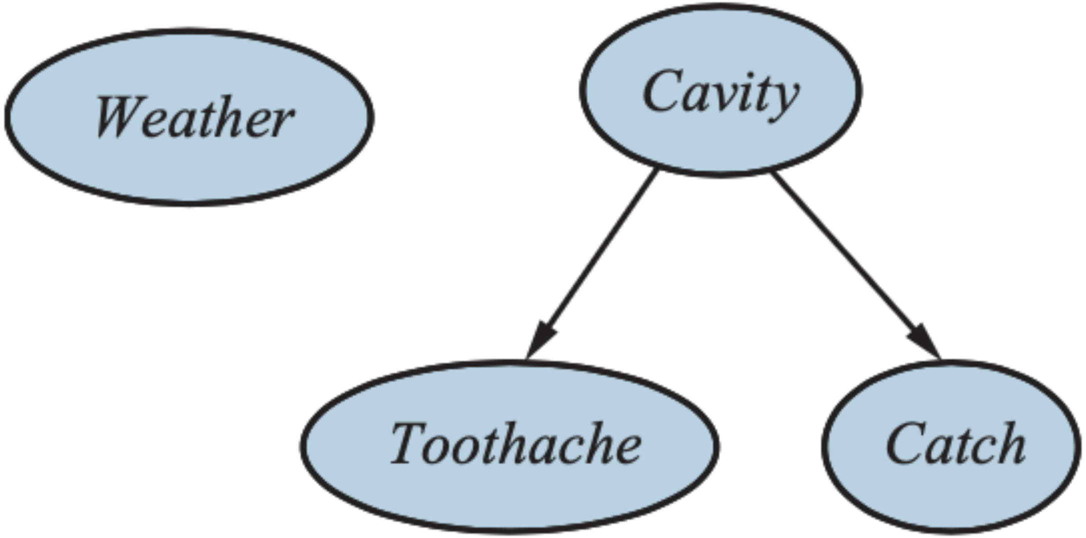
Some variables are

independent or **conditional independent**

Example



Example

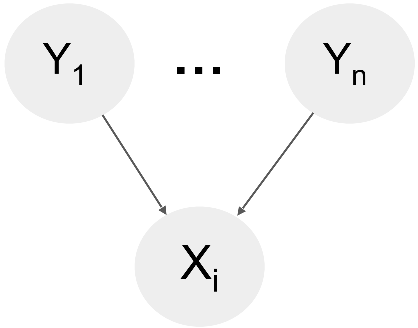


Bayes Net Semantics

- Bayes net = Topology (directed graph) + Local Conditional Probabilities
  - Graph
    - Nodes: random variables
    - Edges: dependency between variables
      - If Y has a direct influence on X, there is an arrow from node Y to node X (Y is a parent of X)
  - A conditional distribution for each node
    - Each node X_i has associated probability information

$$P(X_i | Parents(X_i))$$

    - **Conditional probability table** (CPT)

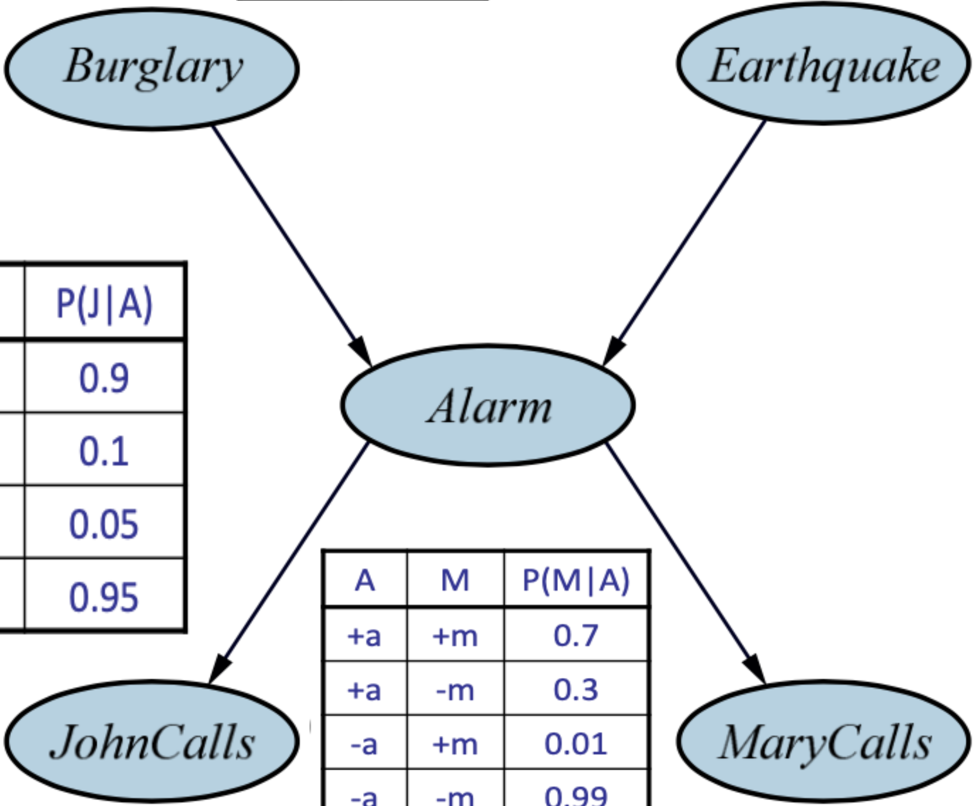


Example

B	P(B)
+b	0.001
-b	0.999

E	P(E)
+e	0.002
-e	0.998

B	E	A	P(A|B,E)
+b	+e	+a	0.95
+b	+e	-a	0.05
+b	-e	+a	0.94
+b	-e	-a	0.06
-b	+e	+a	0.29
-b	+e	-a	0.71
-b	-e	+a	0.001
-b	-e	-a	0.999

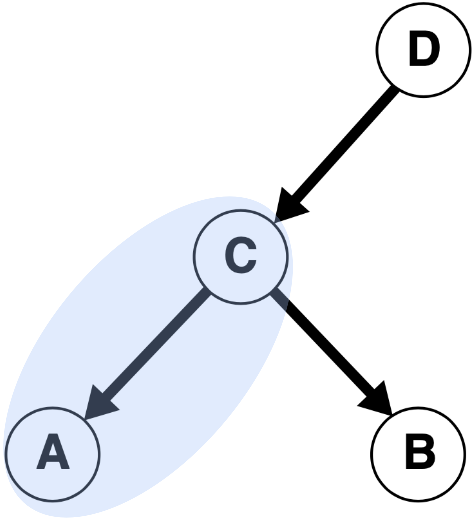


A	J	P(J|A)
+a	+j	0.9
+a	-j	0.1
-a	+j	0.05
-a	-j	0.95

A	M	P(M|A)
+a	+m	0.7
+a	-m	0.3
-a	+m	0.01
-a	-m	0.99

Local Markov Property

- A node in a Bayes net is **conditionally independent** of all of its non-descendants (including its ancestors), if its parents are given
  - e.g., A is conditionally independent of both B and D given C



D is parent of C

A is child of C

B is descendant of D

D is ancestor of A

Probabilities in Bayes Nets

- Bayes nets implicitly encode joint distributions
- Given a Bayes net containing *n* variables, X_i,..., X_n, and the Bayes net defines the probability to a full assignment as

$$P(x_1, \ldots, x_n) = \prod_{i=1}^{n} P(x_i | parents(X_i))$$

where *parents*(X_i) denotes the values of *Parents*(X_i) that appear in x_1,..., x_n

Probabilities in Bayes Nets: $P(x_1, \ldots, x_n) = \prod_{i=1}^{n} P(x_i | parents(X_i))$

$= P(x_n, x_{n-1}, \ldots, x_1)$ (topological ordering)

$$P(x_1, \ldots, x_n) = P(x_n | x_{n-1}, \ldots, x_1) P(x_{n-1}, \ldots, x_1)$$ (product rule)

(chain rule)

$$= P(x_n | x_{n-1}, \ldots, x_1) P(x_{n-1} | x_{n-2}, \ldots, x_1) \cdots P(x_2 | x_1) P(x_1)$$

$$= \prod_{i=1}^{n} P(x_i | x_{i-1}, \ldots, x_1)$$

$$= \prod_{i=1}^{n} P(x_i | parents(X_i))$$

(if Parents(X_i) $\subseteq \{X_{i-1}, \ldots, X_1\}$ and $\{X_1, \ldots, X_i\}$ is topological order of the Bayes Net)

Conditional Independence

- **Conditional independence** of two variables A and B, given a third variable C, i.e., $A \perp\!\!\!\perp B \mid C$, is defined as

$$\mathbf{P}(A,B|C) = \mathbf{P}(A|C)\mathbf{P}(B|C)$$

$P(A,B) = P(A)P(B)$

Equivalent forms: $P(A|B,C) = P(A|C)$ and $P(B|A,C) = P(B|C)$

$P(A|B) = P(A)$ $P(B|A) = P(B)$

* analogy

Claim: P(A,B | C) = P(A |C) P(B |C)
≡ P(A |B,C) = P(A |C) and P(B |A,C) = P(B |C)

$$\mathbf{P}(A,B|C) = \mathbf{P}(A|C)\mathbf{P}(B|C)$$

$$\Rightarrow \frac{\mathbf{P}(A,B,C)}{\mathbf{P}(C)} = \mathbf{P}(A|C)\frac{\mathbf{P}(B,C)}{\mathbf{P}(C)}$$

$$\Rightarrow \frac{\mathbf{P}(A|B,C)\mathbf{P}(B,C)}{\mathbf{P}(C)} = \mathbf{P}(A|C)\frac{\mathbf{P}(B,C)}{\mathbf{P}(C)}$$

$$\Rightarrow \mathbf{P}(A|B,C) = \mathbf{P}(A|C)$$

by the def. of conditional probability:

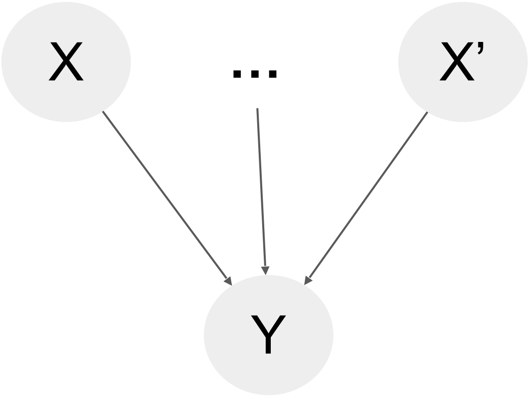
$$\mathbf{P}(A,B|C) = \frac{\mathbf{P}(A,B,C)}{\mathbf{P}(C)}$$

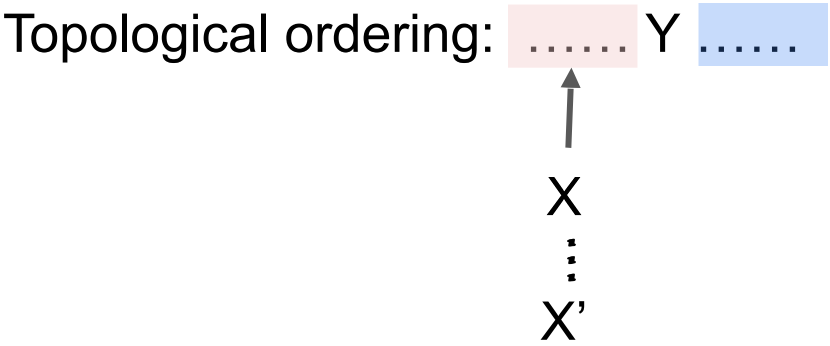
$$\mathbf{P}(B|C) = \frac{\mathbf{P}(B,C)}{\mathbf{P}(C)}$$

$$\mathbf{P}(A,B,C) = \mathbf{P}(A|B,C)\mathbf{P}(B,C)$$

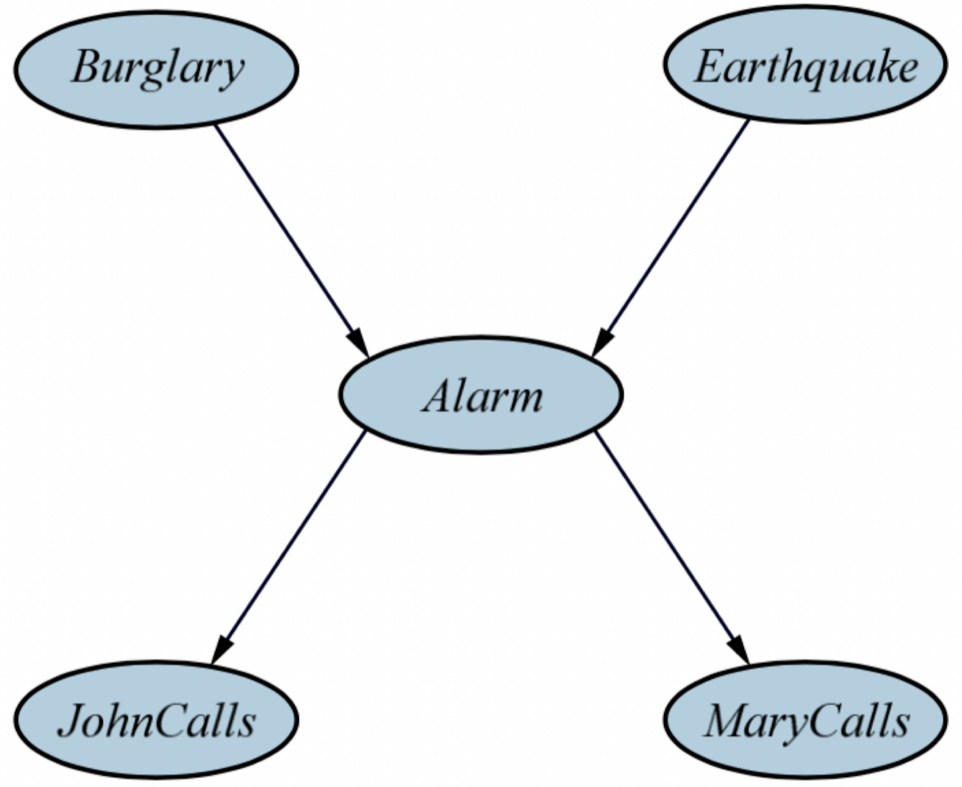
Topological Ordering (Topological Sort)

- Given a directed acyclic graph (DAG), a topological ordering is a linear ordering of nodes such that for every directed edge <X,Y> from node X to node Y, X comes before Y in the ordering





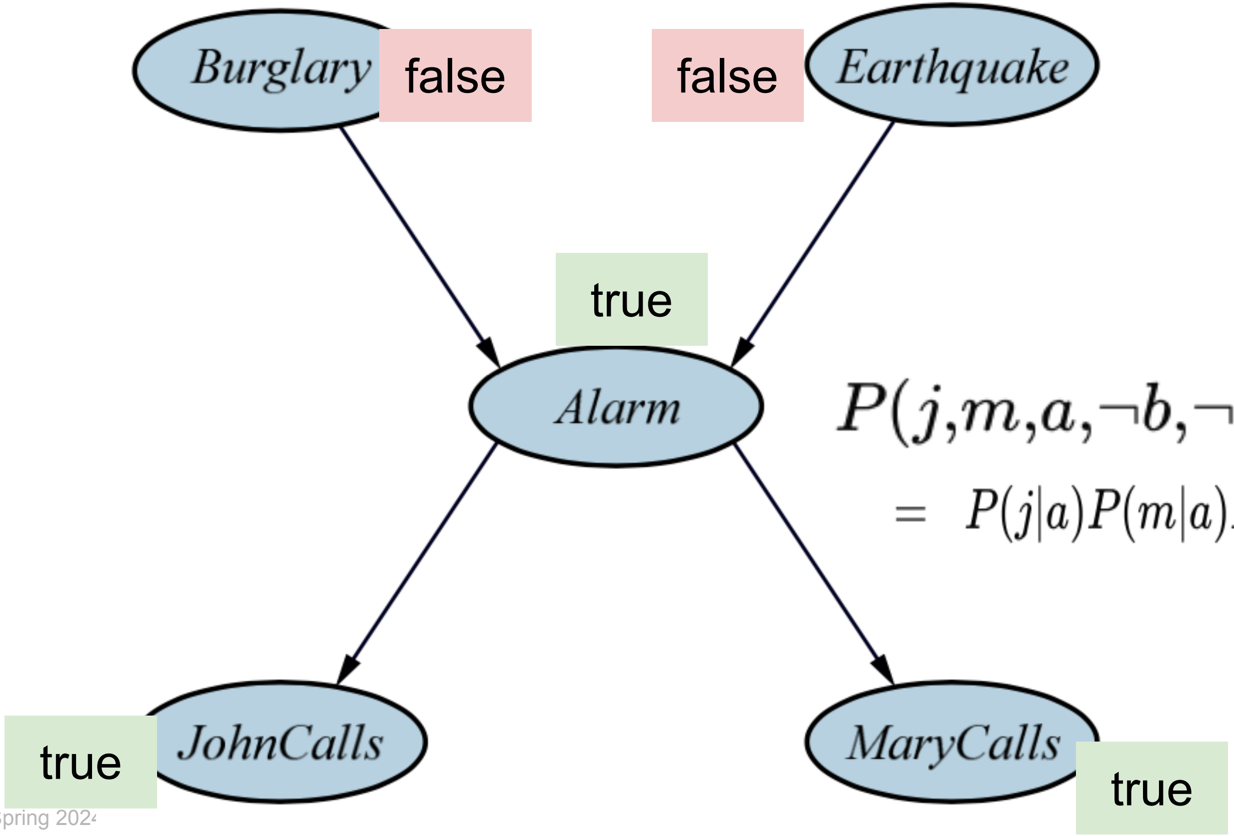
Example: Topological Ordering



- B, E, A, J, M
- E, B, A, M, J
- …

Example

$$P(x_1,\ldots,x_n) = \prod_{i=1}^{n} P(x_i|parents(X_i))$$



$$P(j,m,a,\neg b,\neg e)$$

$$= P(j|a)P(m|a)P(a|\neg b \wedge \neg e)P(\neg b)P(\neg e)$$

Example

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-b	0.999

E	P(E)
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B	E	A	P(A|B,E)
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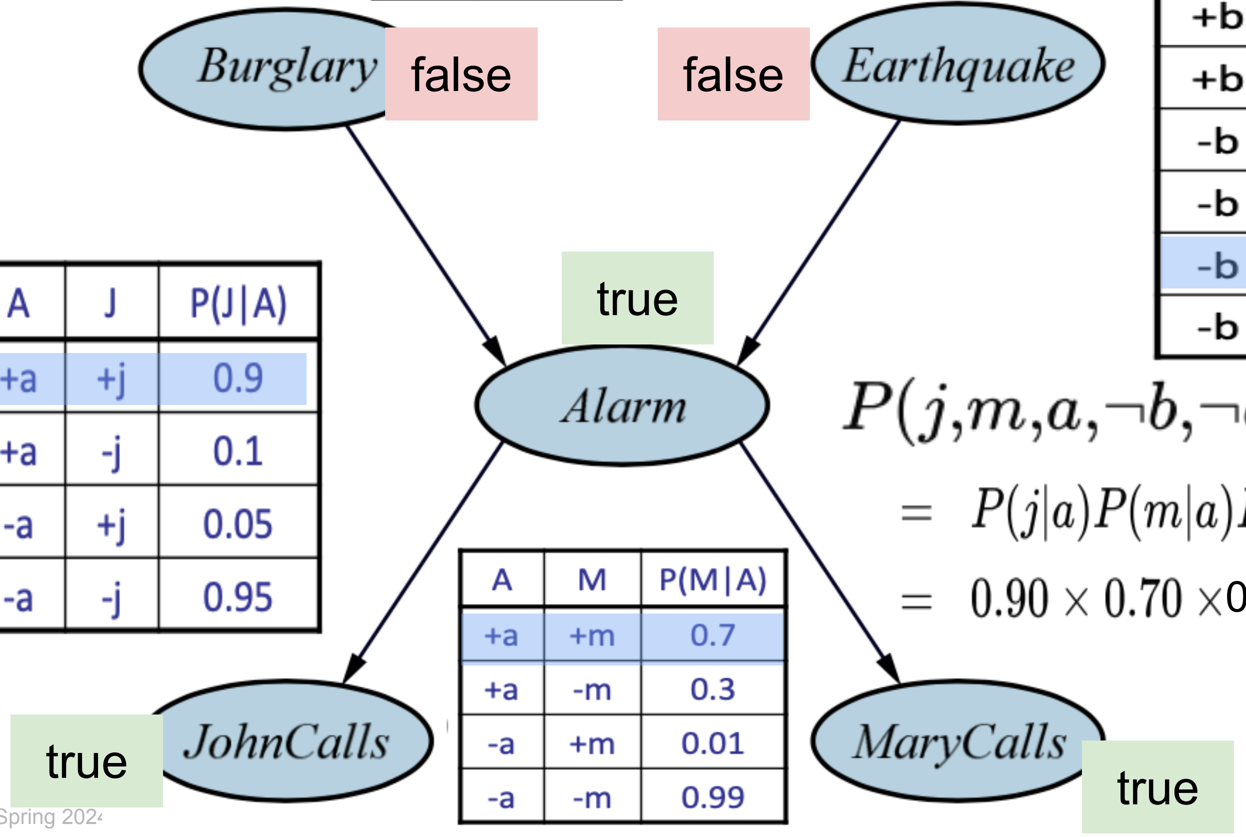
+b	-e	-a	0.06
-b	+e	+a	0.29
-b	+e	-a	0.71
-b	-e	+a	0.001
-b	-e	-a	0.999



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-a	-j	0.95

A	M	P(M|A)
+a	+m	0.7
+a	-m	0.3
-a	+m	0.01
-a	-m	0.99

$$P(j,m,a,\neg b,\neg e)$$
$$= P(j|a)P(m|a)P(a|\neg b \wedge \neg e)P(\neg b)P(\neg e)$$
$$= 0.90 \times 0.70 \times 0.001 \times 0.999 \times 0.998 = 0.000628$$

Construction of Bayes Nets

- Nodes
  - First determine the set of variables that are required to model the domain
  - Now order them, $\{X_1,...,X_n\}$
    - Any order will work
      - The resulting network will be more compact if the variables are ordered such that causes precede effects
- Links: For i = 1 to n do:
  - Choose a **minimal** set S of parents for X_i from $\{X_1,...,X_{i-1}\}$, such that $P(X_i \mid X_{i-1},...,X_1) = P(X_i \mid Parents(X_i))$
  - For each parent insert a link from the parent to X_i
  - CPTs: Write down the conditional probability table, $P(X_i|Parents(X_i))$

Example 1

- Node order: B, E, A, J, M
- Links:

Example 1

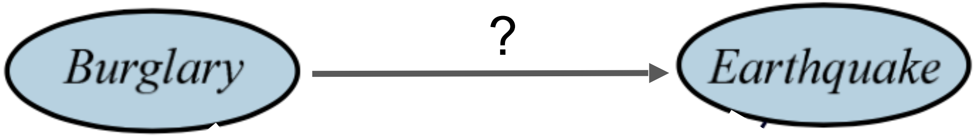
- Node order: B, E, A, J, M
- Links:
  - X_1=B

Example 1

- Node order: B, E, A, J, M
- Links:
  - X_1=B
  - X_2=E

Example 1

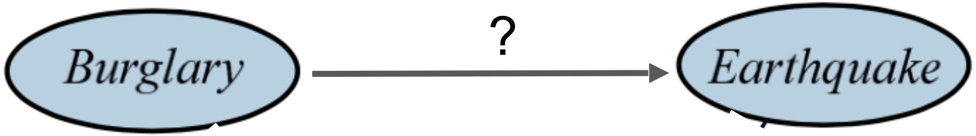
- Node order: B, E, A, J, M
- Links:
  - X_1=B
  - X_2=E
    - Minimal Parents(E) = {?}⊆{B}



Example 1

- Node order: B, E, A, J, M
- Links:
  - X_1=B
  - X_2=E
    - Minimal Parents(E) = {?}⊆{B}
    - Check $B \perp\!\!\!\perp E$?

      by P(B,E) = P(B)P(E)



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- Node order: B, E, A, J, M
- Links:
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  - X_2=E
    - Minimal Parents(E) = {?}⊆{B}
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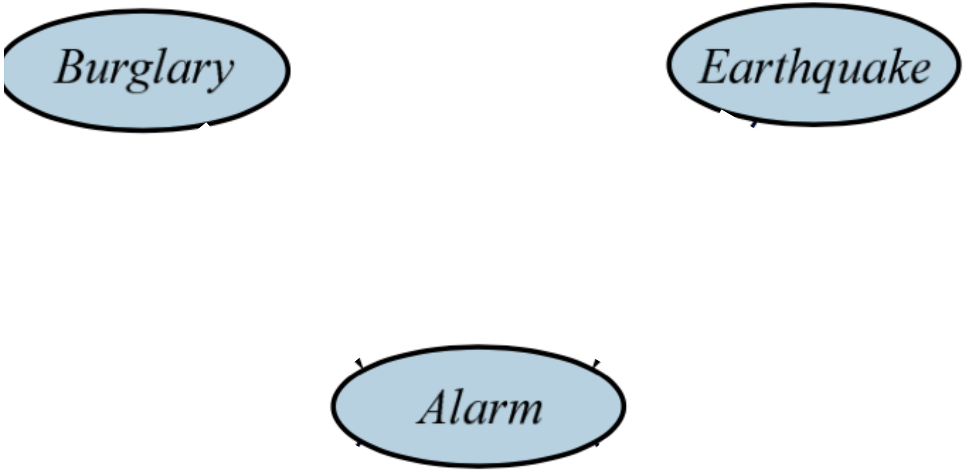
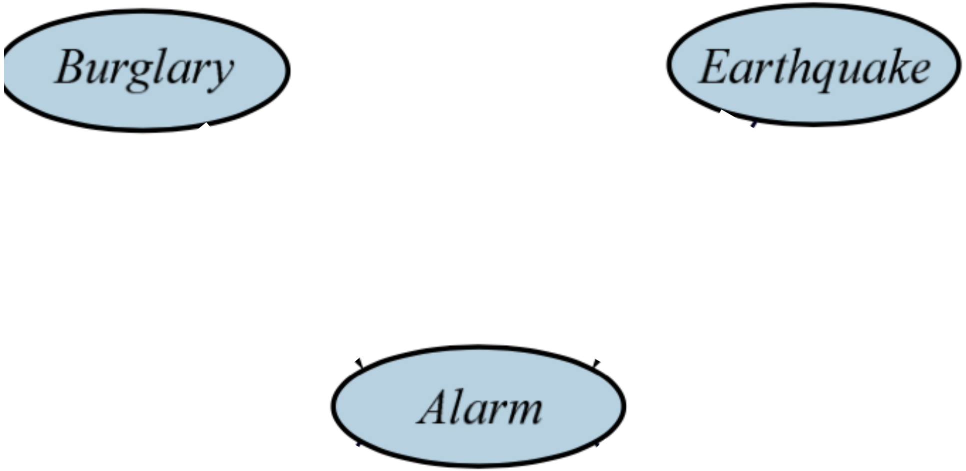
Example 1

- Node order: B, E, A, J, M
- Links:
  - X_1=B
  - X_2=E
    - Minimal Parents(E) = {?}⊆{B}
    - Check B⫫ E ?
      by P(B,E) = P(B)P(E)
  - X_3=A



Example 1

- Node order: B, E, A, J, M
- Links:
  - X_1=B
  - X_2=E
    - Minimal Parents(E) = {?}⊆{B}
    - Check B⫫ E ?
      by P(B,E) = P(B)P(E)
  - X_3=A
    - Minimal Parents(A)={?}⊆{E,B}



Example 1

- Node order: B, E, A, J, M
- Links:
  - X_1=B
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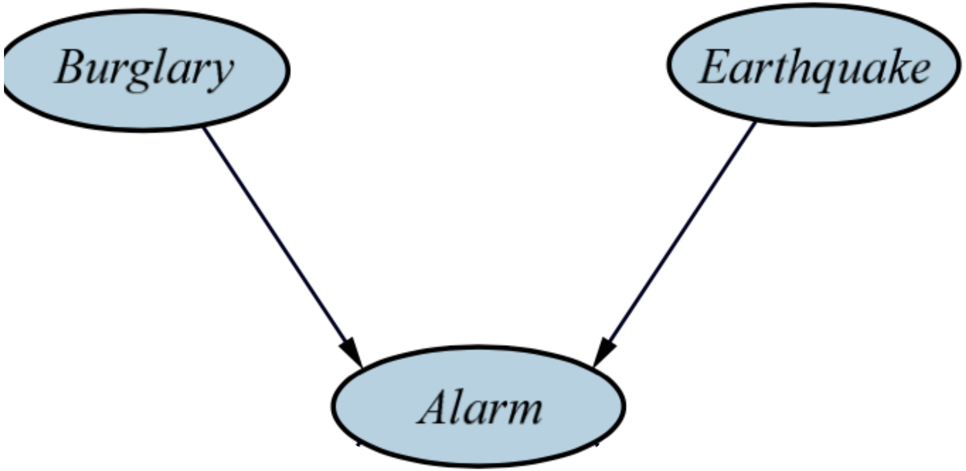
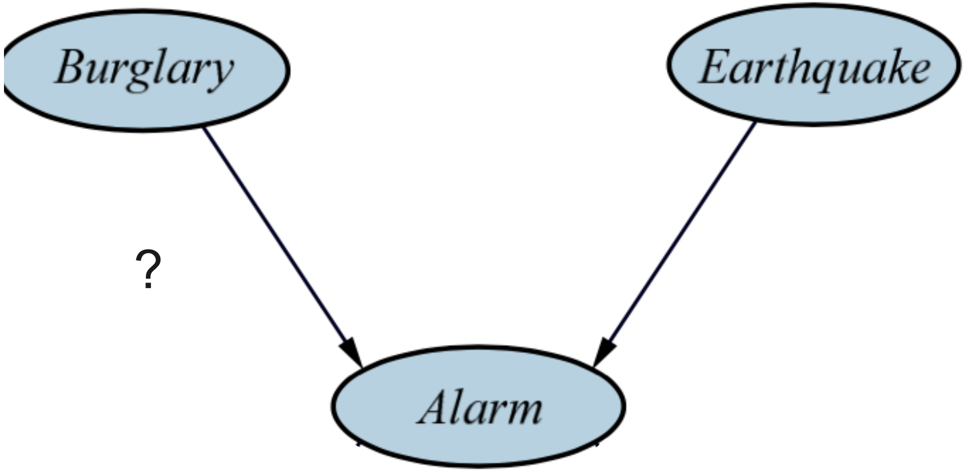
    - Minimal Parents(E) = {?}⊆{B}
    - Check B⫫ E ?
      by P(B,E) = P(B)P(E)
  - X_3=A
    - Minimal Parents(A)={?}⊆{E,B}



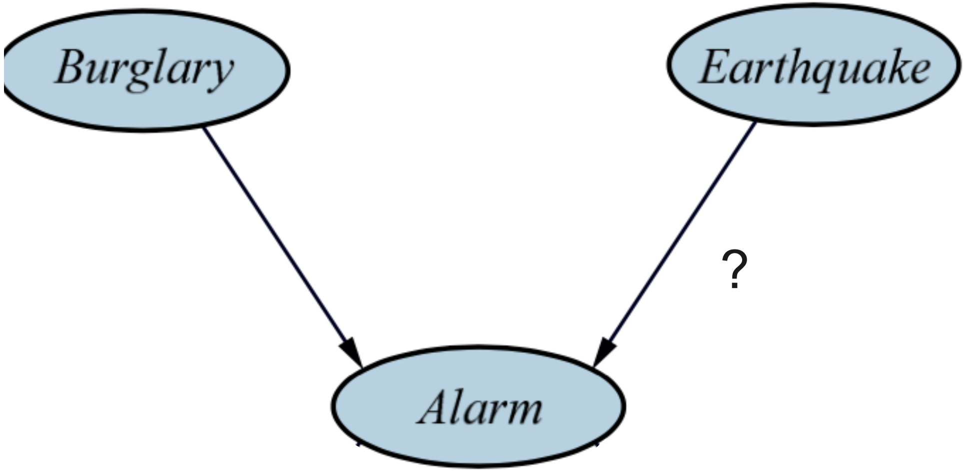
Example 1

- Node order: B, E, A, J, M
- Links:
  - X_1=B
  - X_2=E
    - Minimal Parents(E) = {?}⊆{B}
    - Check B ⫫ E ?
      by P(B,E) = P(B)P(E)
  - X_3=A
    - Minimal Parents(A)={?}⊆{E,B}
    - Check A ⫫ B|E ? by P(A,B |E) = P(A|E)P(B|E)



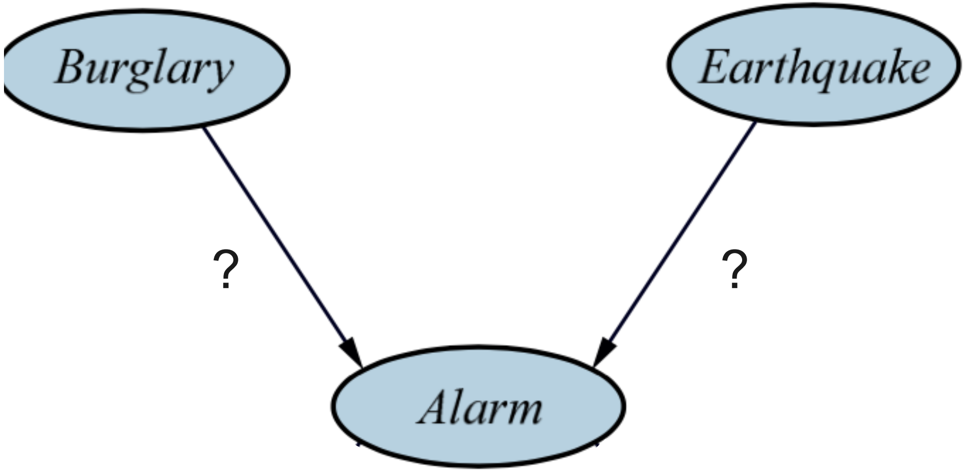
Example 1

- Node order: B, E, A, J, M
- Links:
  - X_1=B
  - X_2=E
    - Minimal Parents(E) = {?}⊆{B}
    - Check B $\perp\!\!\!\perp$ E ?
      by P(B,E) = P(B)P(E)
  - X_3=A
    - Minimal Parents(A)={?}⊆{E,B}
    - Check A $\perp\!\!\!\perp$ B|E ? by P(A,B |E) = P(A|E)P(B|E)
    - Check A $\perp\!\!\!\perp$ E|B ? by P(A,E |B) = P(A|B)P(E|B)



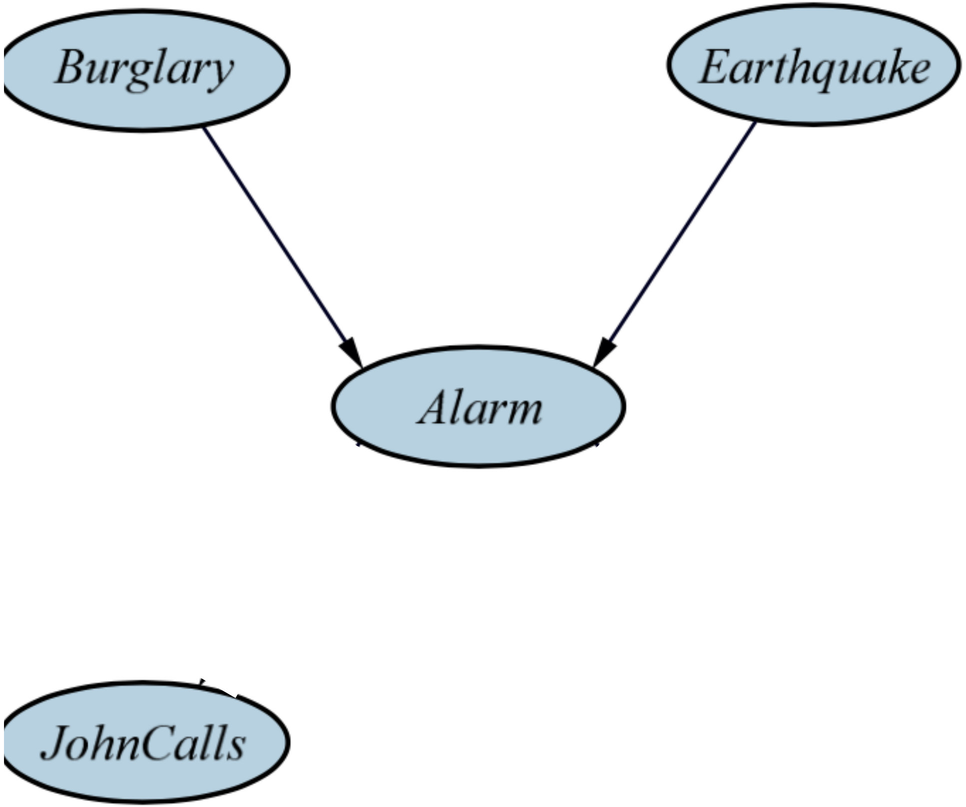
Example 1

- Node order: B, E, A, J, M
- Links:
  - X_1=B
  - X_2=E
    - Minimal Parents(E) = {?}⊆{B}
    - Check B $\perp\!\!\!\perp$ E ?
      by P(B,E) = P(B)P(E)
  - X_3=A
    - Minimal Parents(A)={?}⊆{E,B}
    - Check A $\perp\!\!\!\perp$ B|E ? by P(A,B |E) = P(A|E)P(B|E)
    - Check A $\perp\!\!\!\perp$ E|B ? by P(A,E |B) = P(A|B)P(E|B)
    - Check A $\perp\!\!\!\perp$(E,B)? by P(A,E,B) = P(A)P(E,B)



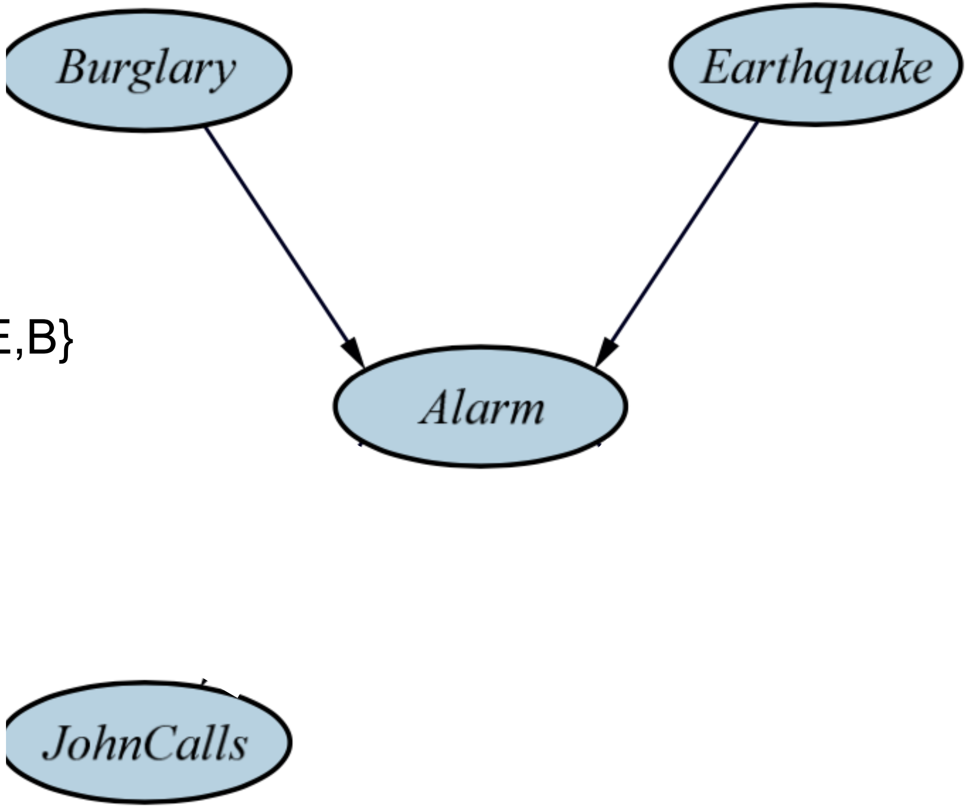
Example 1

- Node order: B, E, A, J, M
- Links:
  - X_4=J



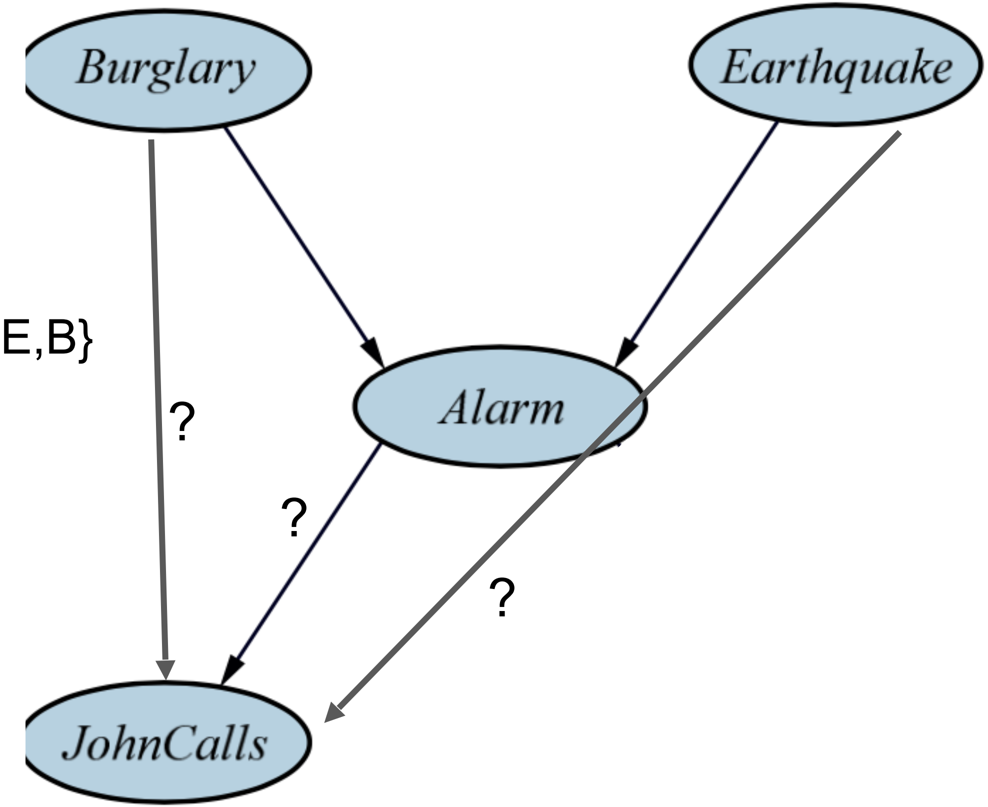
Example 1

- Node order: B, E, A, J, M
- Links:
  - X_4=J
    - Minimal Parents(J) = {?}⊆{A,E,B}



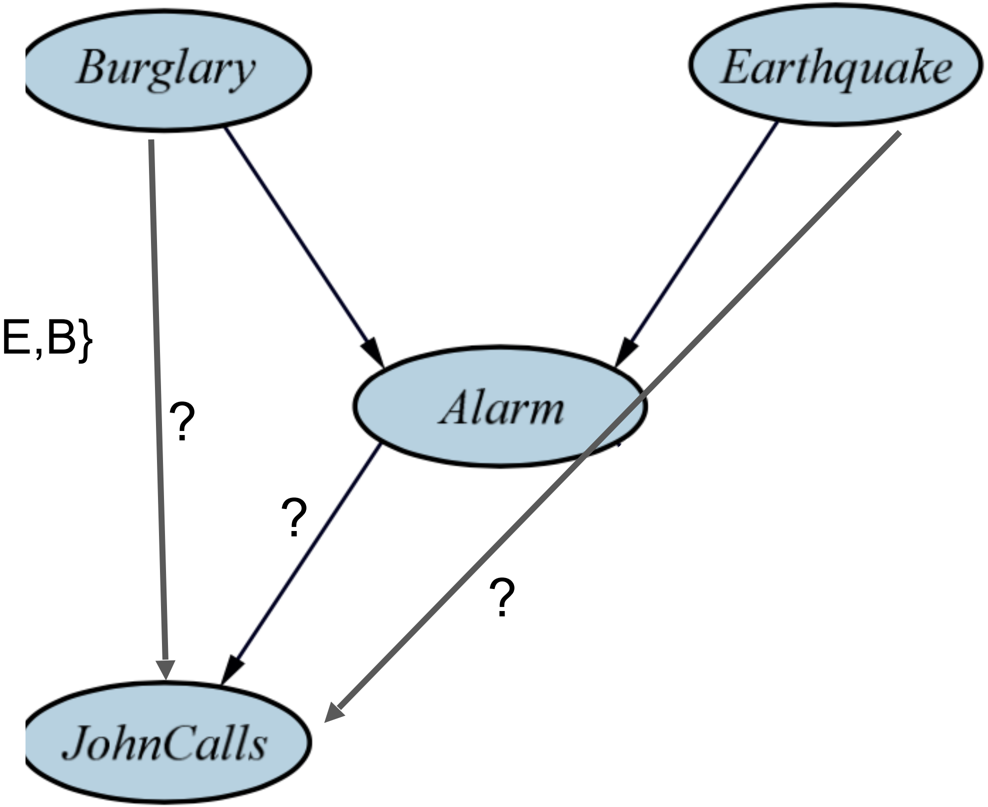
Example 1

- Node order: B, E, A, J, M
- Links:
  - X_4=J
    - Minimal Parents(J) = {?}⊆{A,E,B}



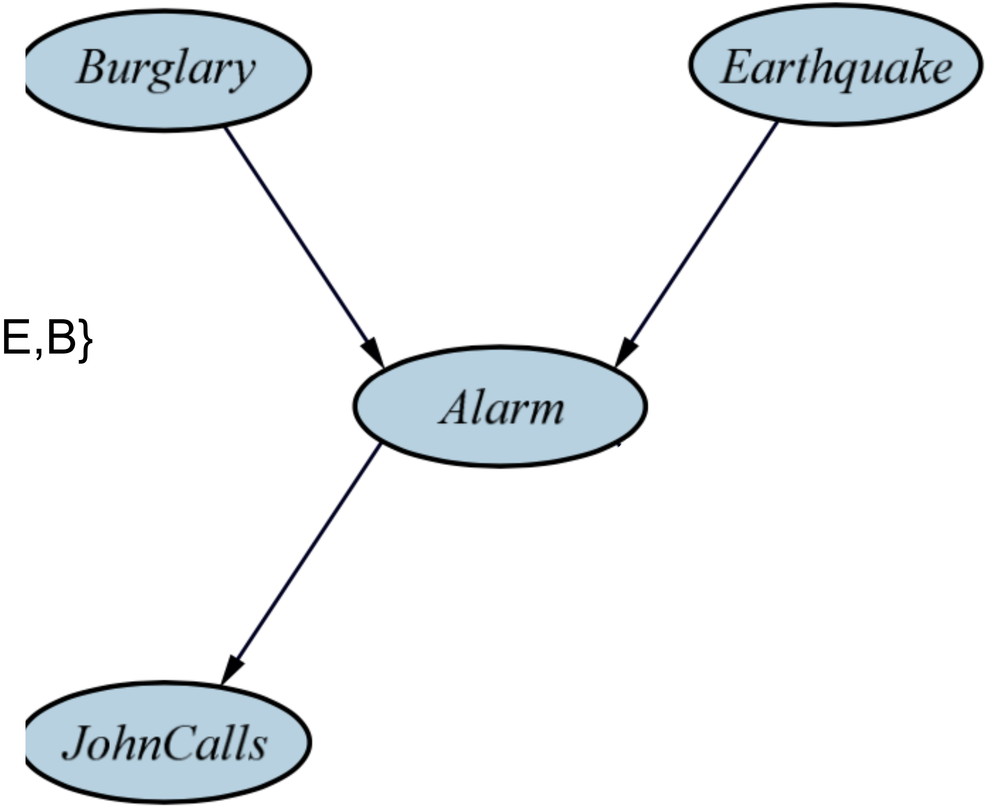
Example 1

- Node order: B, E, A, J, M
- Links:
  - X_4=J
    - Minimal Parents(J) = $\{?\} \subseteq \{A,E,B\}$
    - Check $J \perp\!\!\!\perp A \mid (B,E)$?
    - Check $J \perp\!\!\!\perp B \mid (A,E)$?
    - Check $J \perp\!\!\!\perp E \mid (A,B)$?
    - Check $J \perp\!\!\!\perp (B,E) \mid A$?
    - Check $J \perp\!\!\!\perp (A,E) \mid B$?
    - Check $J \perp\!\!\!\perp (A,B) \mid E$?
    - Check $J \perp\!\!\!\perp (A,E,B)$?



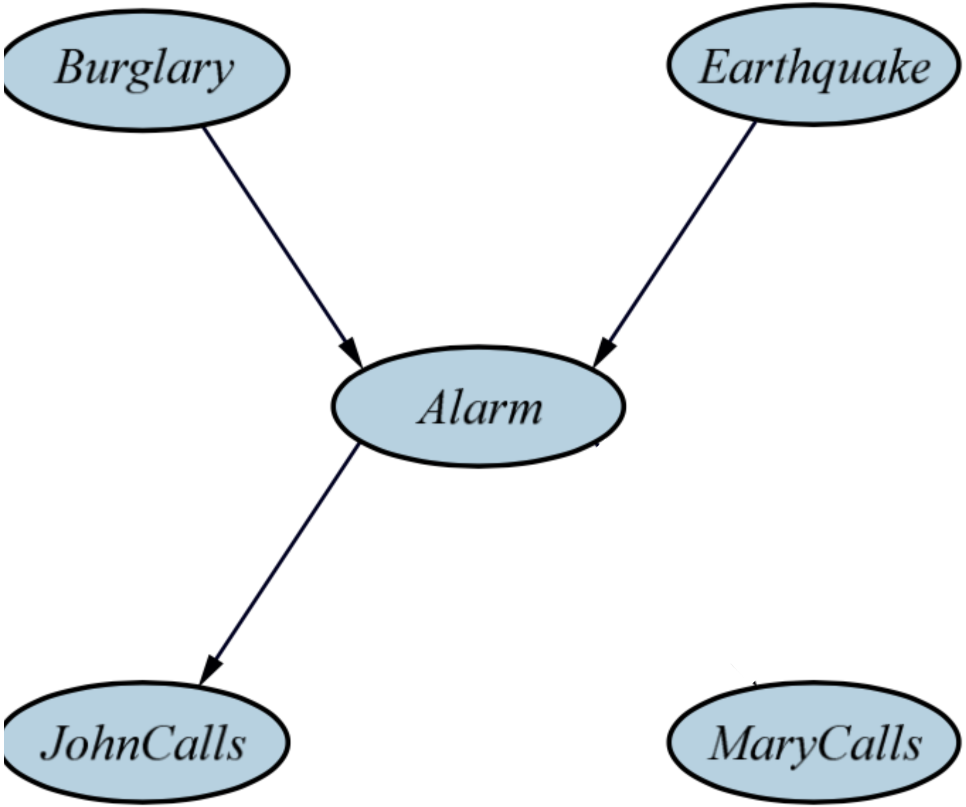
Example 1

- Node order: B, E, A, J, M
- Links:
  - X_4=J
    - Minimal Parents(J) = {?}$\subseteq${A,E,B}
    - Check J $\perp\!\!\!\perp$ A|(B,E) ?
    - Check J $\perp\!\!\!\perp$ B|(A,E) ? $C_1^3 = 3$
    - Check J $\perp\!\!\!\perp$ E|(A,B) ?
    - Check J $\perp\!\!\!\perp$ (B,E)|A ?
    - Check J $\perp\!\!\!\perp$ (A,E)|B ? $C_2^3 = 3$
    - Check J $\perp\!\!\!\perp$ (A,B)|E ?
    - Check J $\perp\!\!\!\perp$(A,E,B) ? $C_3^3 = 1$



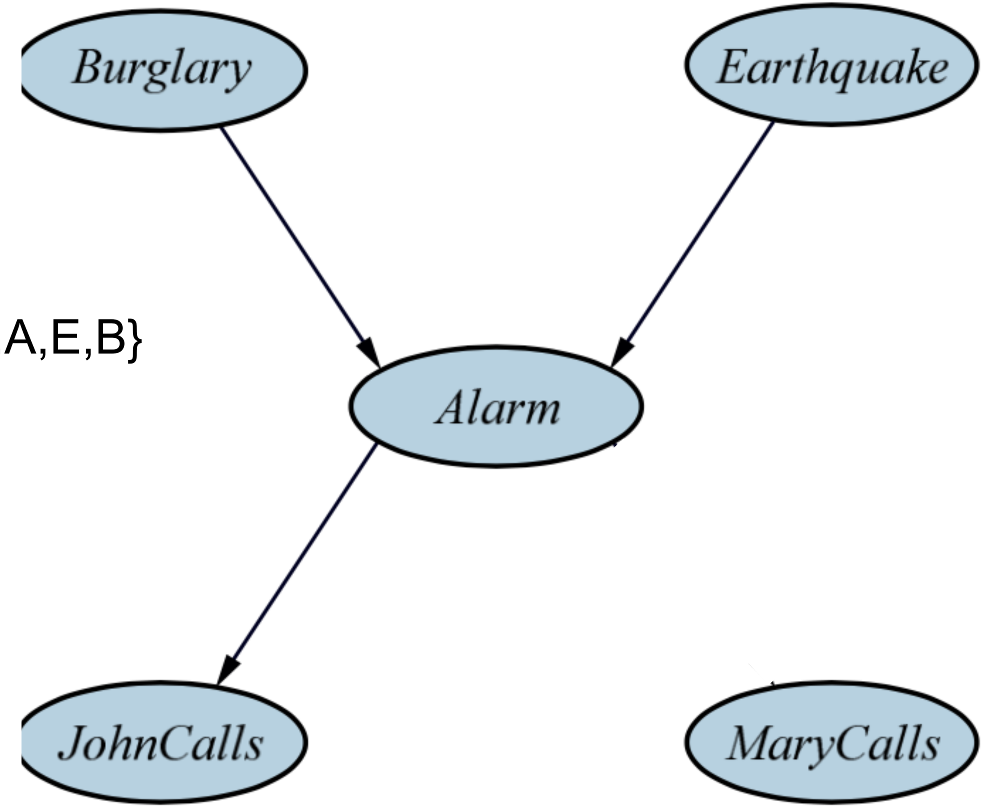
Example 1

- Node order: B, E, A, J, M
- Links:
  - X_5=M



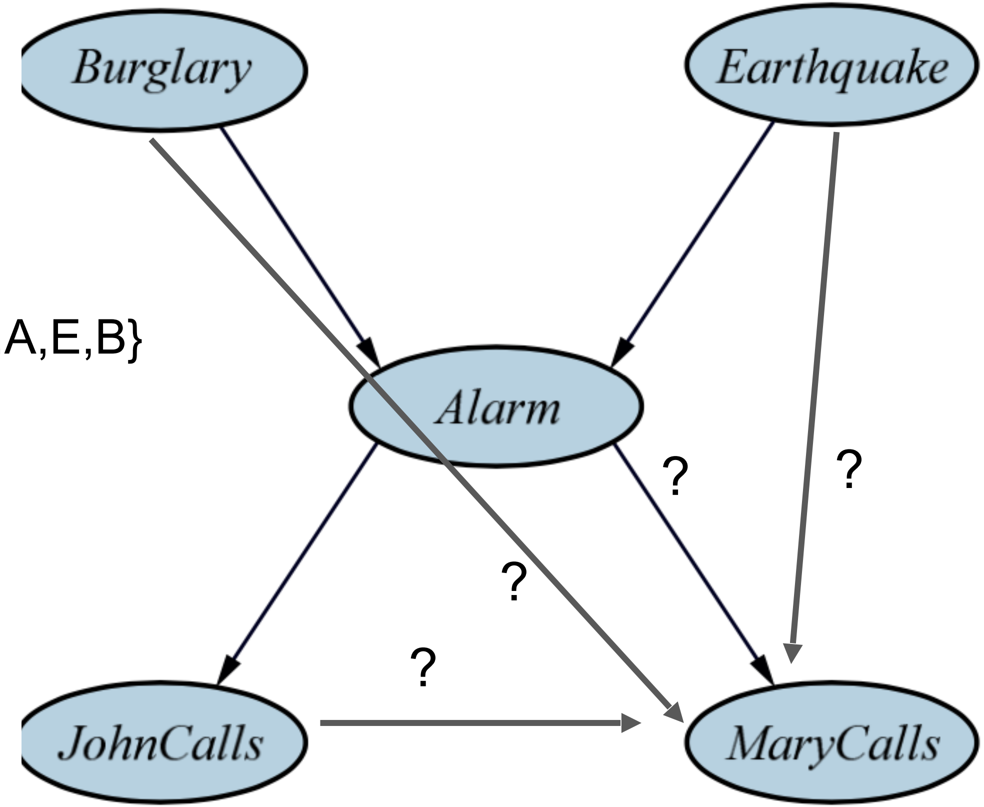
Example 1

- Node order: B, E, A, J, M
- Links:
    - X_5=M
        - Minimal Parents(M) = {?}⊆{J,A,E,B}



Example 1

- Node order: B, E, A, J, M
- Links:
  - X_5=M
    - Minimal Parents(M) = {?}⊆{J,A,E,B}



Example 1

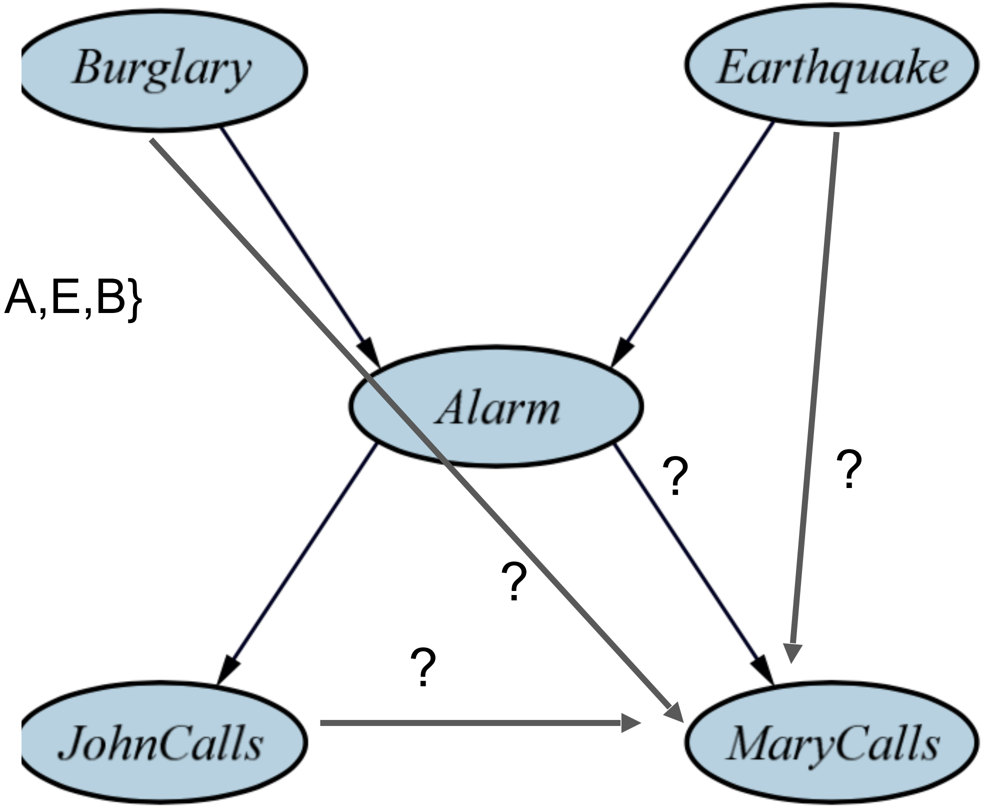
- Node order: B, E, A, J, M
- Links:
  - X_5=M
    - Minimal Parents(M) = {?}$\subseteq${J,A,E,B}

$C^4_1 = 4$

    - Check M $\perp\!\!\!\perp$ A|(B,E,J) ?
    - Check M $\perp\!\!\!\perp$ B|(A,E,J) ?
    - Check M $\perp\!\!\!\perp$ E|(A,B,J) ?
    - Check M $\perp\!\!\!\perp$ J|(A,B,E) ?

$C^4_2 = 6$

    - Check M $\perp\!\!\!\perp$ (B,E)|(A,J) ?
    - Check M $\perp\!\!\!\perp$ (B,A)|(E,J) ?
    - Check M $\perp\!\!\!\perp$ (B,J)|(E,A) ?
    - Check M $\perp\!\!\!\perp$ (E,A)|(B,J) ?
    - Check M $\perp\!\!\!\perp$ (E,J)|(B,A) ?
    - Check M $\perp\!\!\!\perp$ (A,J)|(B,E) ?

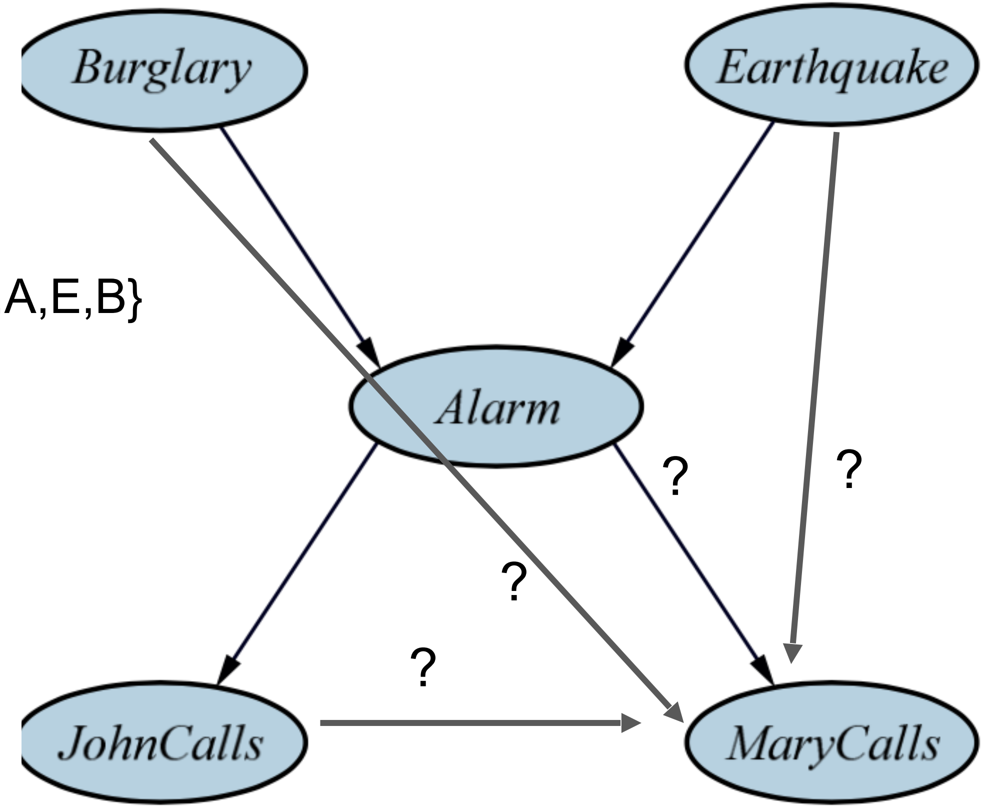


Example 1

- Node order: B, E, A, J, M
- Links:
  - X_5=M
    - Minimal Parents(M) = {?}⊆{J,A,E,B}
    - …
    - Check M ⫫ (B,E,J)|A ?
    - Check M ⫫ (A,E,J)|B ?
    - Check M ⫫ (A,B,J)|E ?
    - Check M ⫫ (A,B,E)|J ?
    - Check M ⫫(J,A,E,B) ?

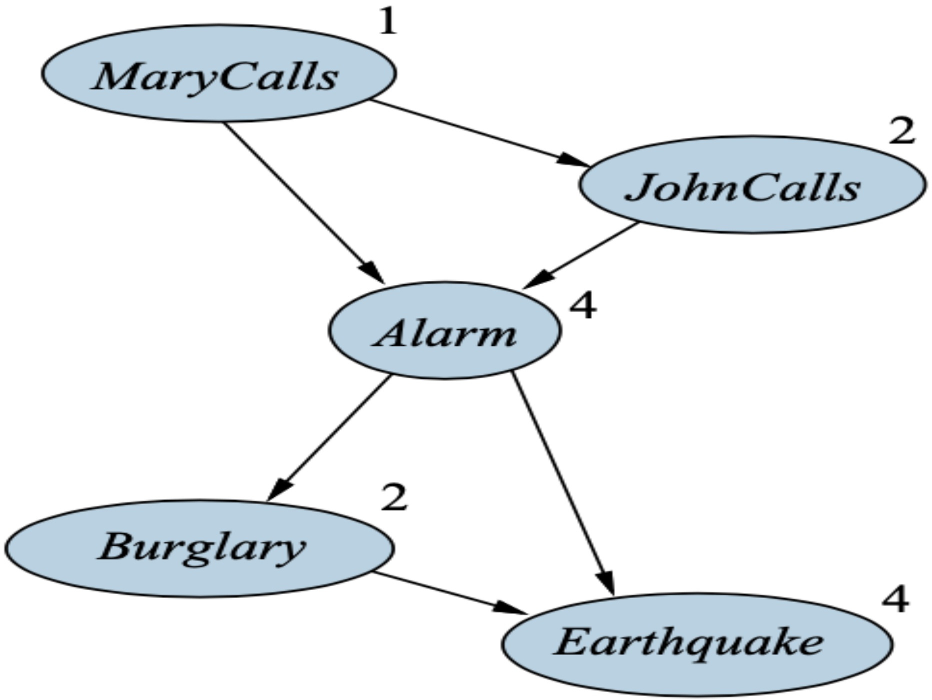
$C_3^4=4$

$C_4^4 = 1$



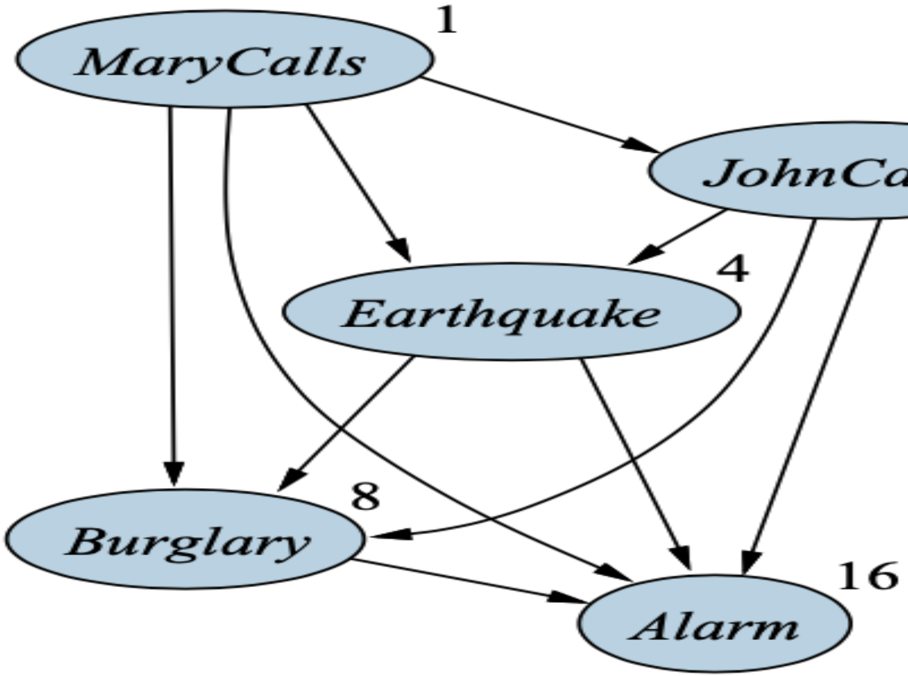
Example 2

- Node order: M, J, A, B, E



Example 3

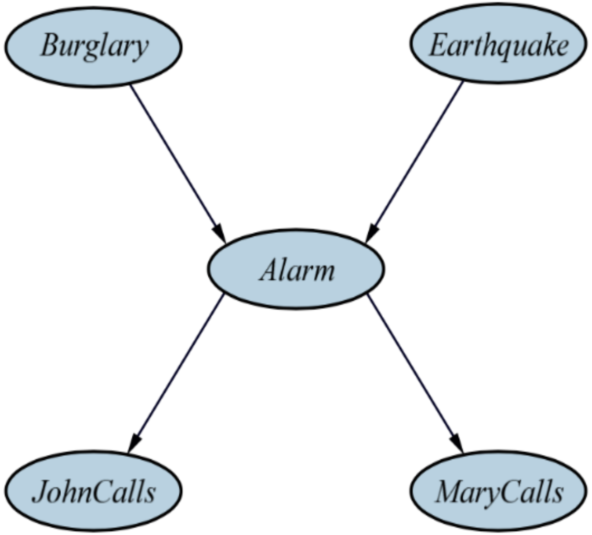
- Node order: M, J, E, B, A

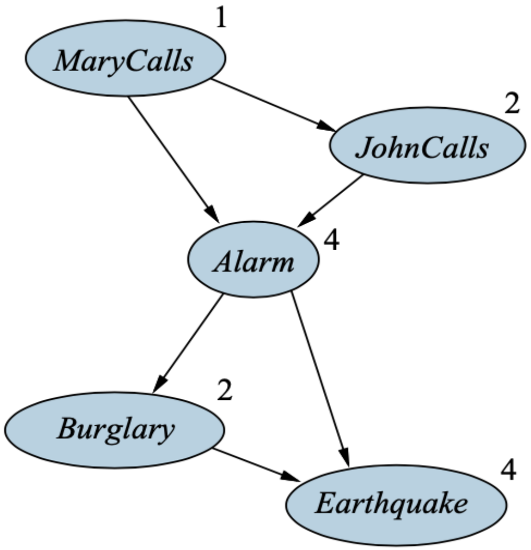


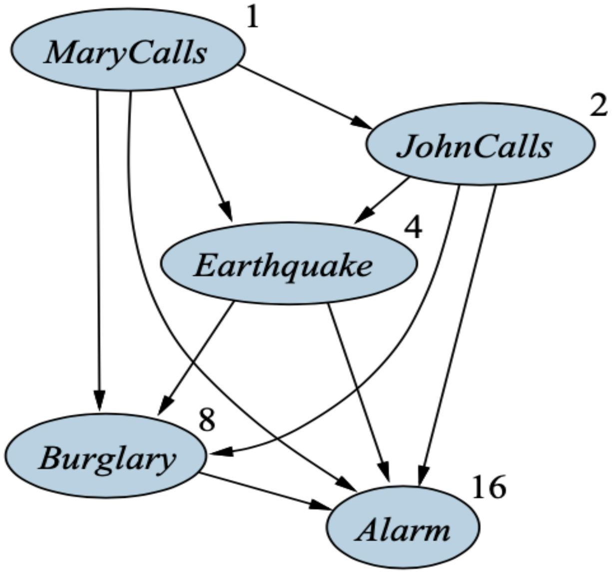
Construction of Bayes Nets

- Nodes
  - First determine the set of variables that are required to model the domain.
  - Now order them, $\{X_1,...,X_n\}$
    - Any order will work, but the resulting network will be more compact if the variables are ordered such that causes precede effects
- Links: For i = 1 to n do:
  - Choose a minimal set S of parents for X_i from $\{X_1,...,X_{i-1}\}$, such that $P(X_i | X_{i-1},...,X_1) = P(X_i | \text{Parents}(X_i))$
  - For each parent insert a link from the parent to X_i
  - CPTs: Write down the conditional probability table, $P(X_i|\text{Parents}(X_i))$

Compactness and Node Ordering







compact → ideal

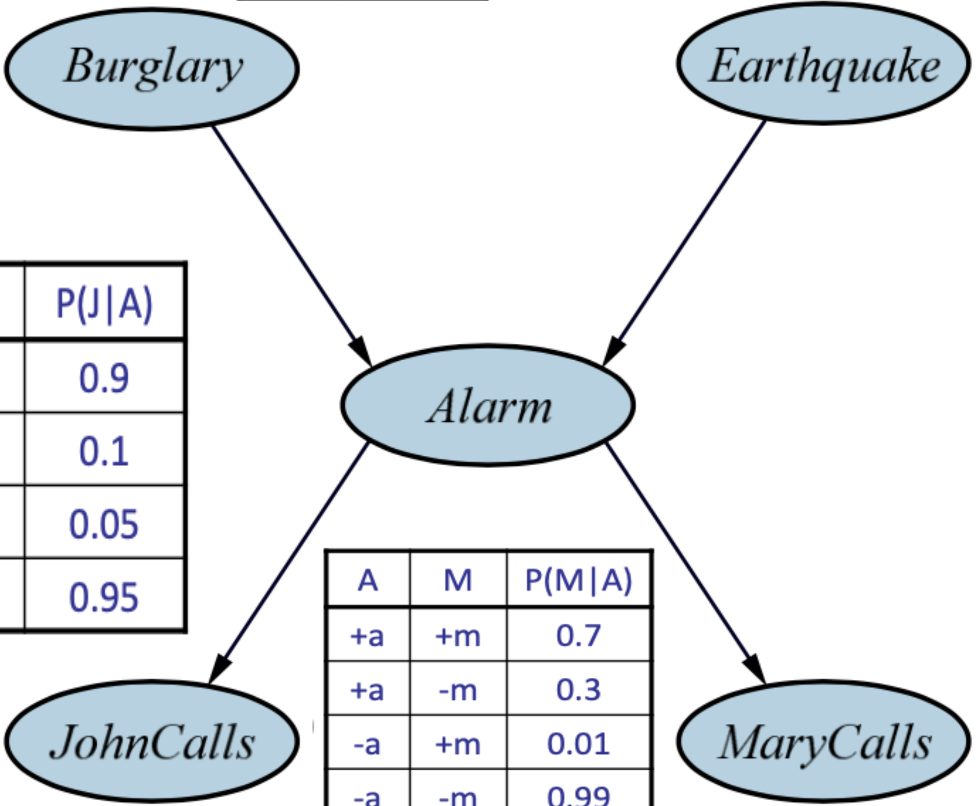
Compactness and Node Ordering

- Compactness
  - More compact than the full joint distribution
  - Example
    - 30 nodes (boolean)
    - Each node has five parents
    - Bayes net requires $30 \times 2^5 = 960$ numbers

Example

B	P(B)
+b	0.001
-b	0.999

E	P(E)
+e	0.002
-e	0.998



B	E	A	P(A|B,E)
+b	+e	+a	0.95
+b	+e	-a	0.05
+b	-e	+a	0.94
+b	-e	-a	0.06
-b	+e	+a	0.29
-b	+e	-a	0.71
-b	-e	+a	0.001
-b	-e	-a	0.999

A	J	P(J|A)
+a	+j	0.9
+a	-j	0.1
-a	+j	0.05
-a	-j	0.95

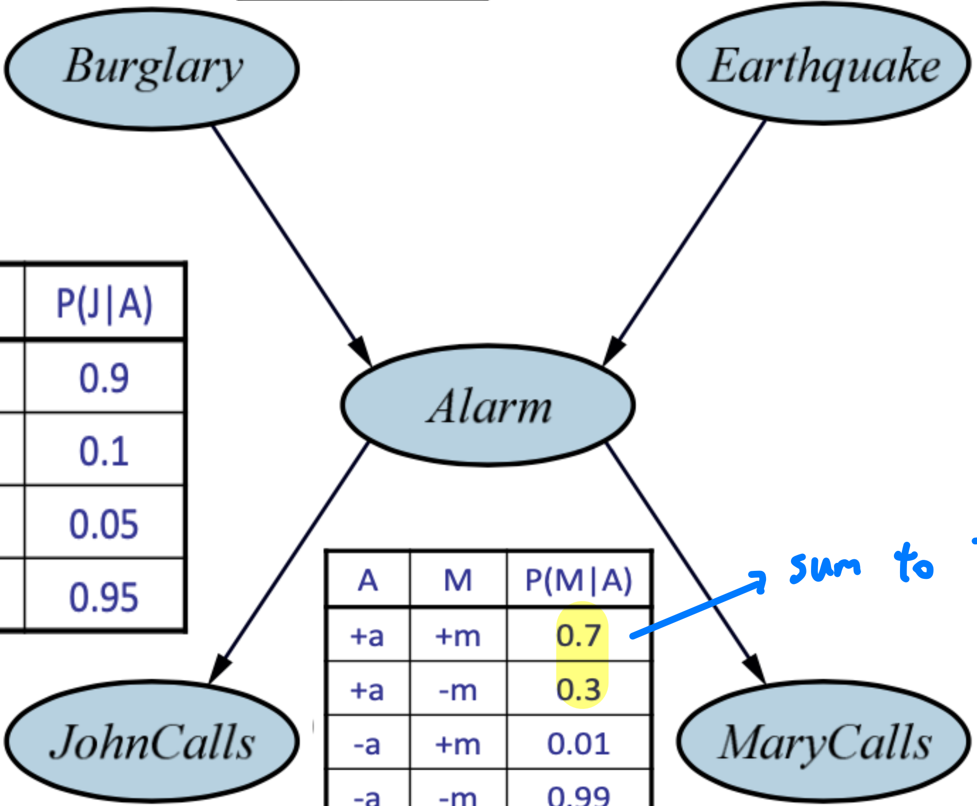
A	M	P(M|A)
+a	+m	0.7
+a	-m	0.3
-a	+m	0.01
-a	-m	0.99

Example

B	P(B)
+b	0.001
-b	0.999

E	P(E)
+e	0.002
-e	0.998

B	E	A	P(A|B,E)
+b	+e	+a	0.95
+b	+e	-a	0.05
+b	-e	+a	0.94
+b	-e	-a	0.06
-b	+e	+a	0.29
-b	+e	-a	0.71
-b	-e	+a	0.001
-b	-e	-a	0.999



A	J	P(J|A)
+a	+j	0.9
+a	-j	0.1
-a	+j	0.05
-a	-j	0.95

A	M	P(M|A)
+a	+m	0.7
+a	-m	0.3
-a	+m	0.01
-a	-m	0.99

sum to 1

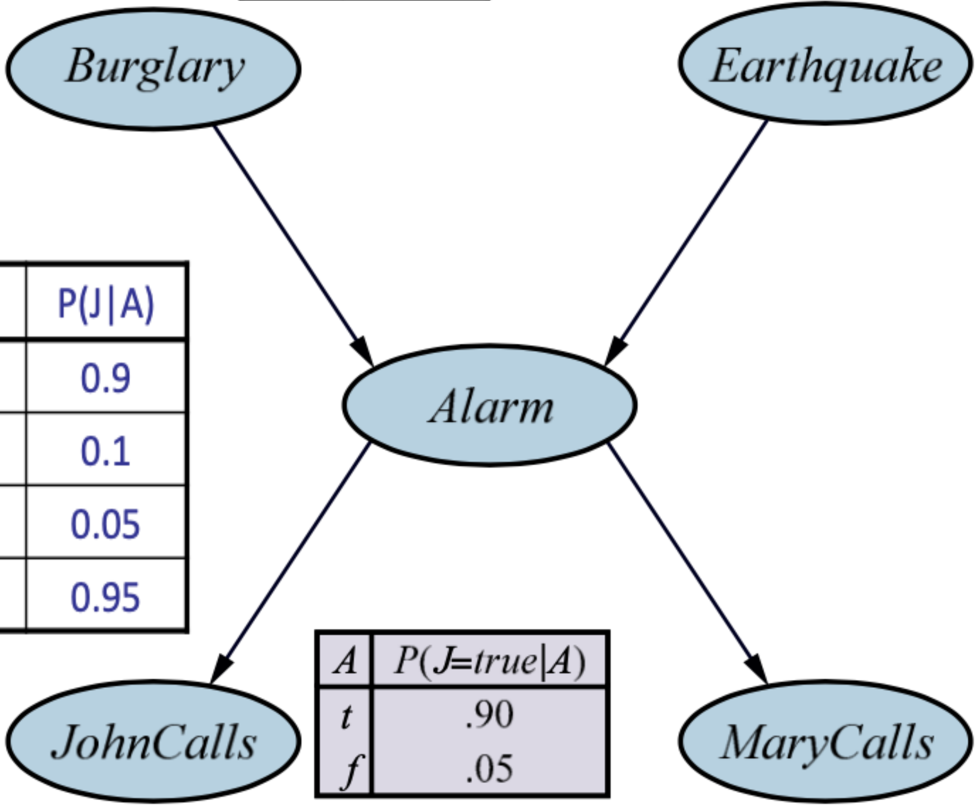
A	$P(M{=}true\|A)$
t	.70
f	.01

Example

B	P(B)
+b	0.001
-b	0.999

E	P(E)
+e	0.002
-e	0.998

B	E	A	P(A|B,E)
+b	+e	+a	0.95
+b	+e	-a	0.05
+b	-e	+a	0.94
+b	-e	-a	0.06
-b	+e	+a	0.29
-b	+e	-a	0.71
-b	-e	+a	0.001
-b	-e	-a	0.999



A	J	P(J|A)
+a	+j	0.9
+a	-j	0.1
-a	+j	0.05
-a	-j	0.95

A	*P(J=true|A)*
t	.90
f	.05

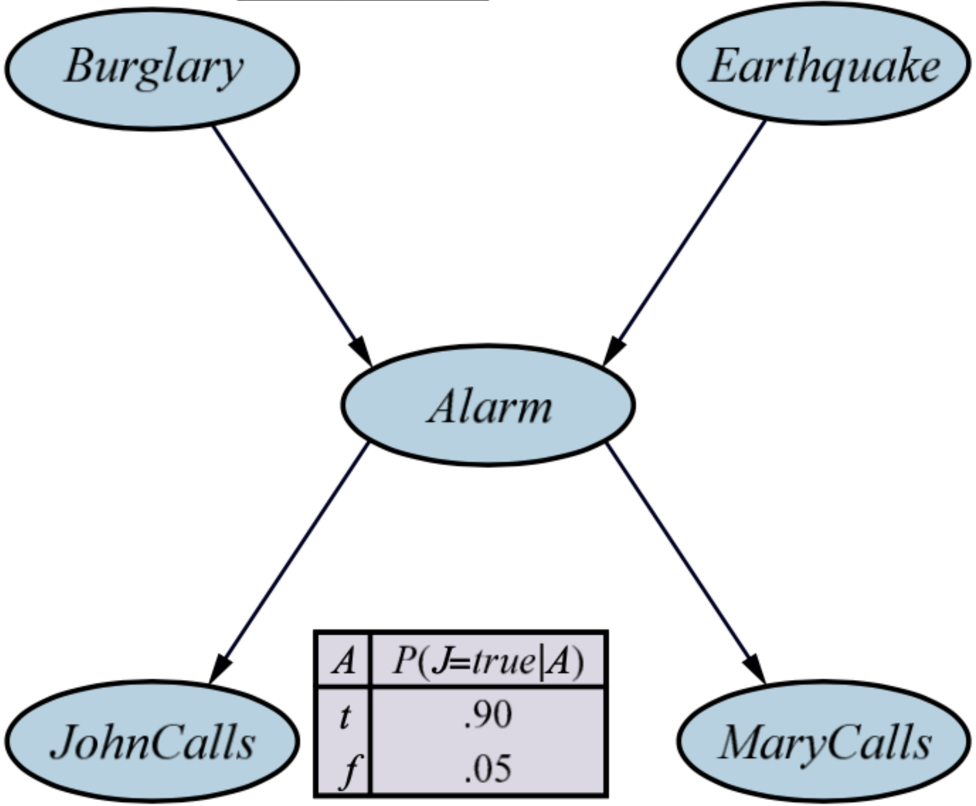
A	*P(M=true|A)*
t	.70
f	.01

Example

B	P(B)
+b	0.001
-b	0.999

E	P(E)
+e	0.002
-e	0.998

B	E	A	P(A|B,E)
+b	+e	+a	0.95
+b	+e	-a	0.05
+b	-e	+a	0.94
+b	-e	-a	0.06
-b	+e	+a	0.29
-b	+e	-a	0.71
-b	-e	+a	0.001
-b	-e	-a	0.999



A	$P(J{=}true \mid A)$
t	.90
f	.05

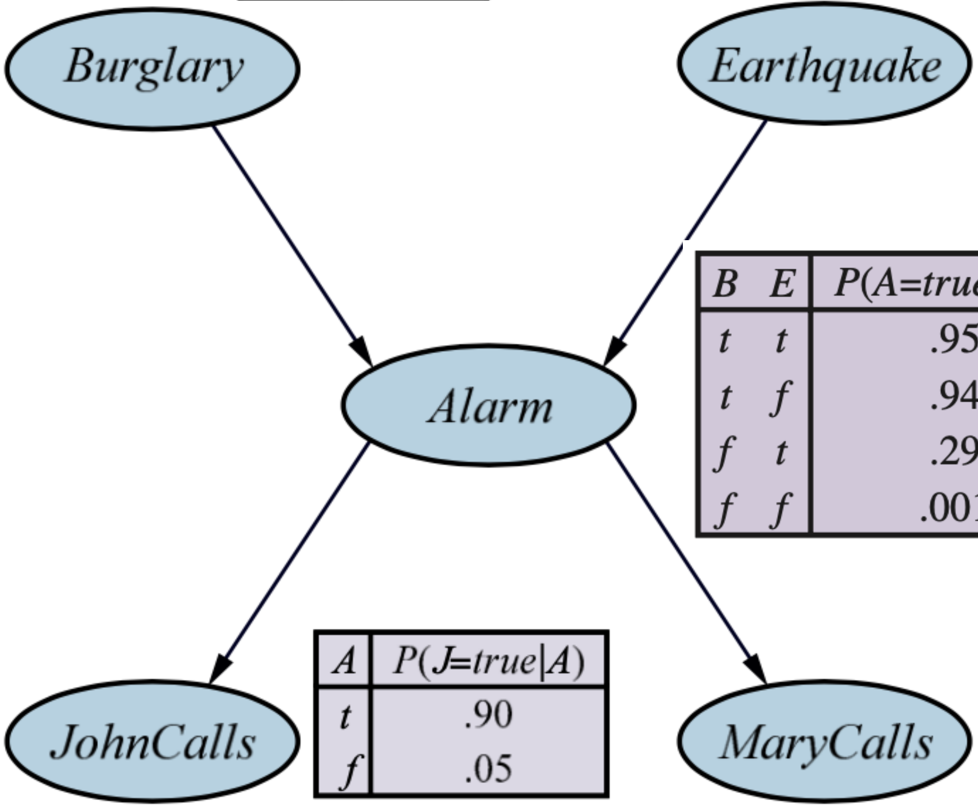
A	$P(M{=}true \mid A)$
t	.70
f	.01

Example

B	P(B)
+b	0.001
-b	0.999

E	P(E)
+e	0.002
-e	0.998

B	E	A	P(A|B,E)
+b	+e	+a	0.95
+b	+e	-a	0.05
+b	-e	+a	0.94
+b	-e	-a	0.06
-b	+e	+a	0.29
-b	+e	-a	0.71
-b	-e	+a	0.001
-b	-e	-a	0.999



B	*E*	*P(A=true|B,E)*
t	*t*	.95
t	*f*	.94
f	*t*	.29
f	*f*	.001

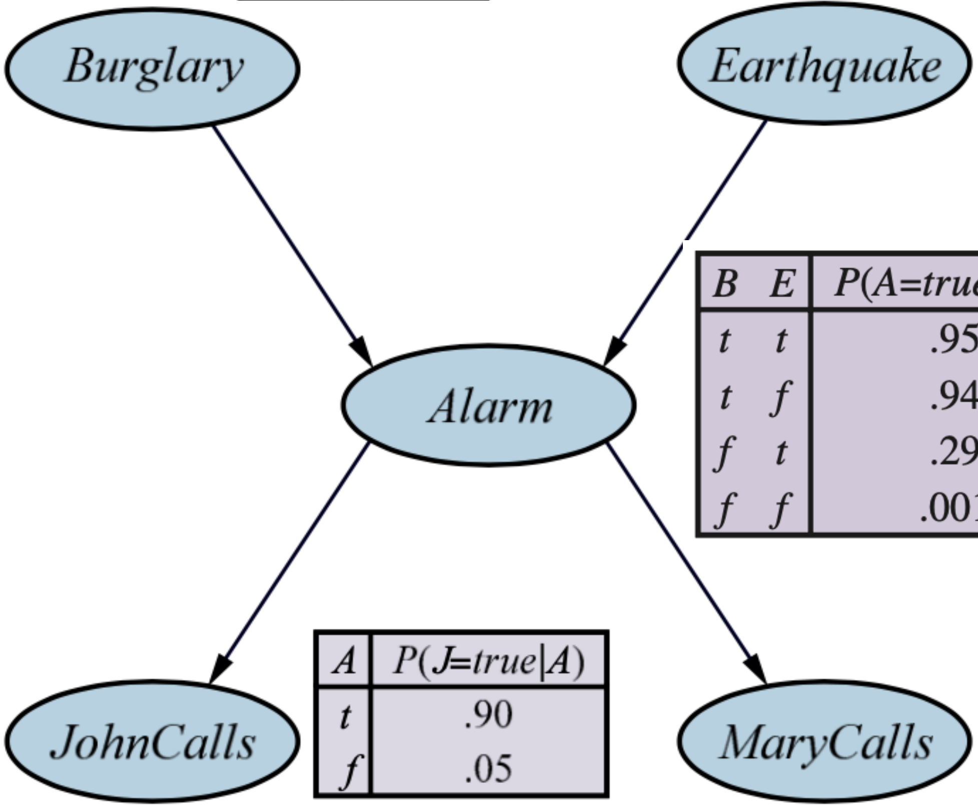
A	*P(J=true|A)*
t	.90
f	.05

A	*P(M=true|A)*
t	.70
f	.01

Example

B	P(B)
+b	0.001
-b	0.999

E	P(E)
+e	0.002
-e	0.998



B	*E*	*P(A=true|B,E)*
t	*t*	.95
t	*f*	.94
f	*t*	.29
f	*f*	.001

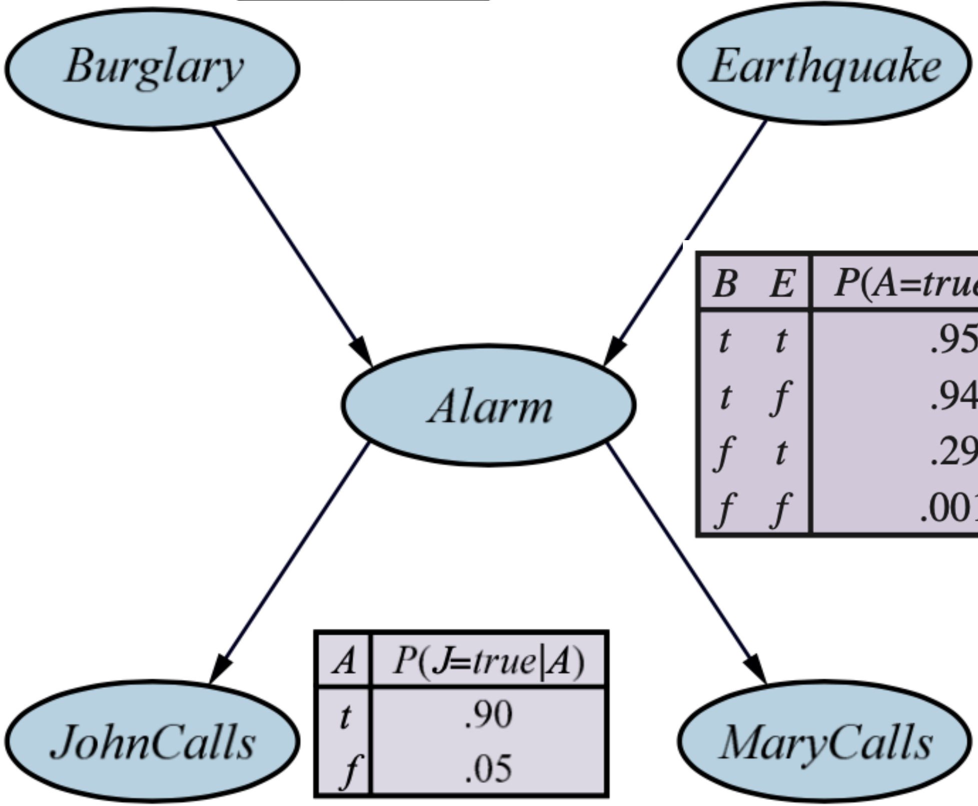
A	*P(J=true|A)*
t	.90
f	.05

A	*P(M=true|A)*
t	.70
f	.01

Example

B	P(B)
+b	0.001
-b	0.999

E	P(E)
+e	0.002
-e	0.998



$P(E{=}true)$
.002

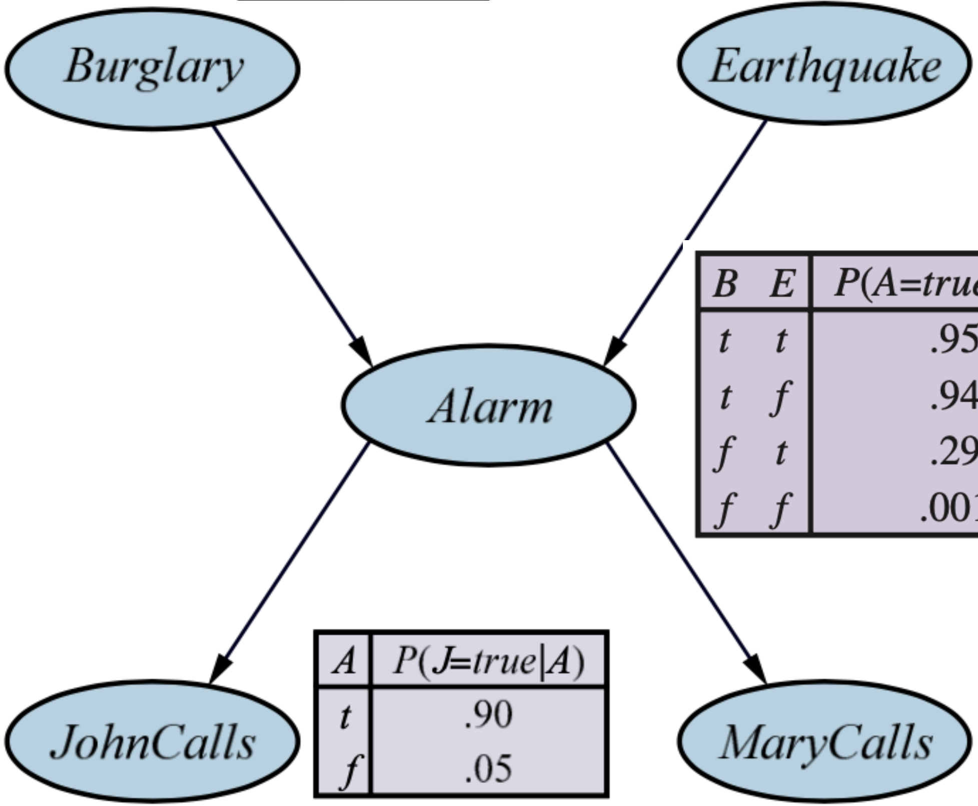
B	E	$P(A{=}true \mid B,E)$
t	t	.95
t	f	.94
f	t	.29
f	f	.001

A	$P(J{=}true \mid A)$
t	.90
f	.05

A	$P(M{=}true \mid A)$
t	.70
f	.01

Example

B	P(B)
+b	0.001
-b	0.999



$P(E=true)$
.002

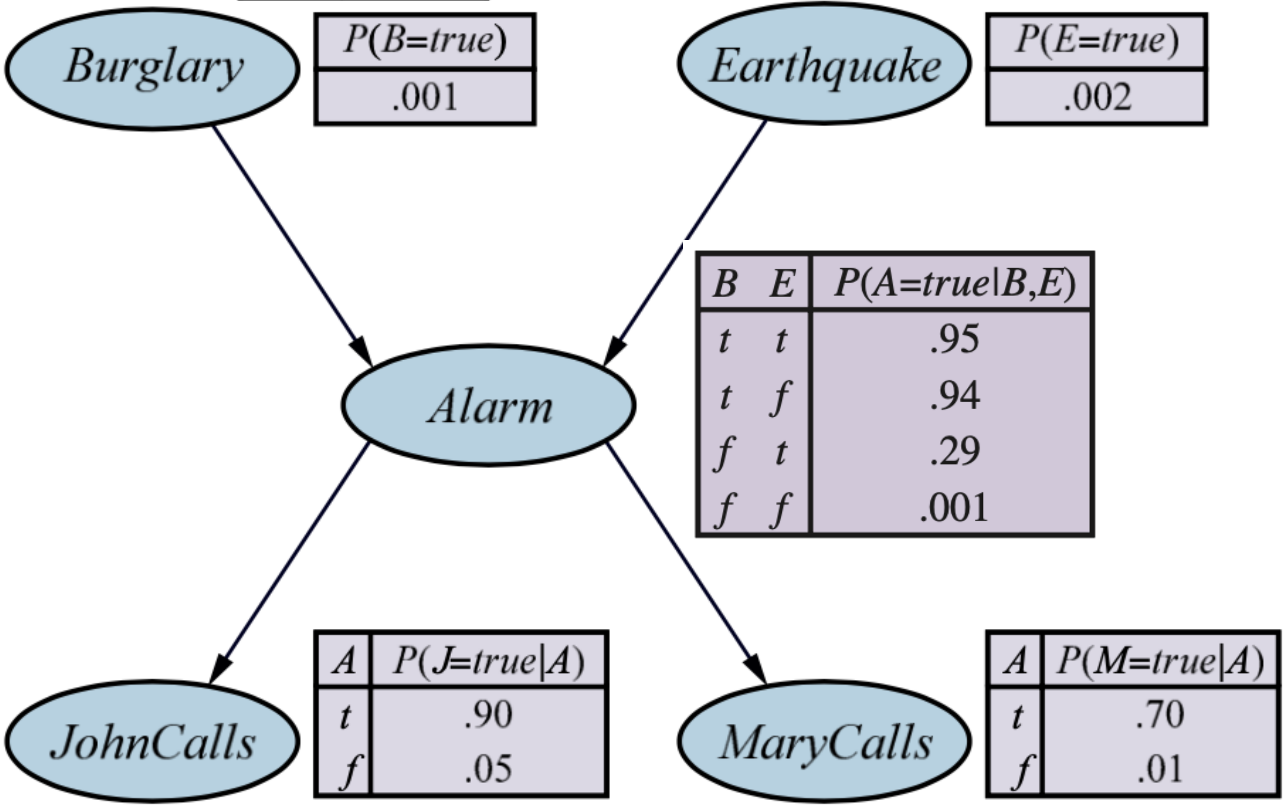
B	E	$P(A=true\|B,E)$
t	t	.95
t	f	.94
f	t	.29
f	f	.001

A	$P(J=true\|A)$
t	.90
f	.05

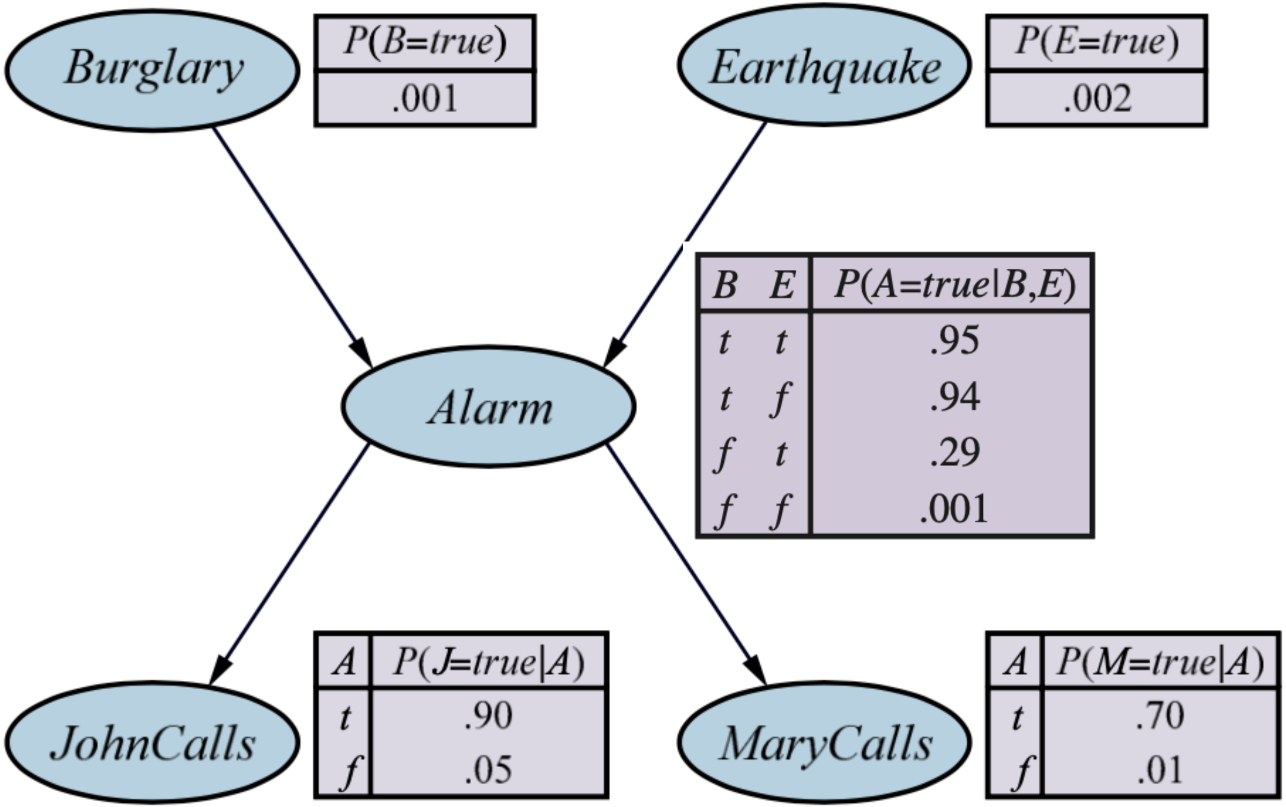
A	$P(M=true\|A)$
t	.70
f	.01

Example

B	P(B)
+b	0.001
-b	0.999



Example



P(B=true)
.001

P(E=true)
.002

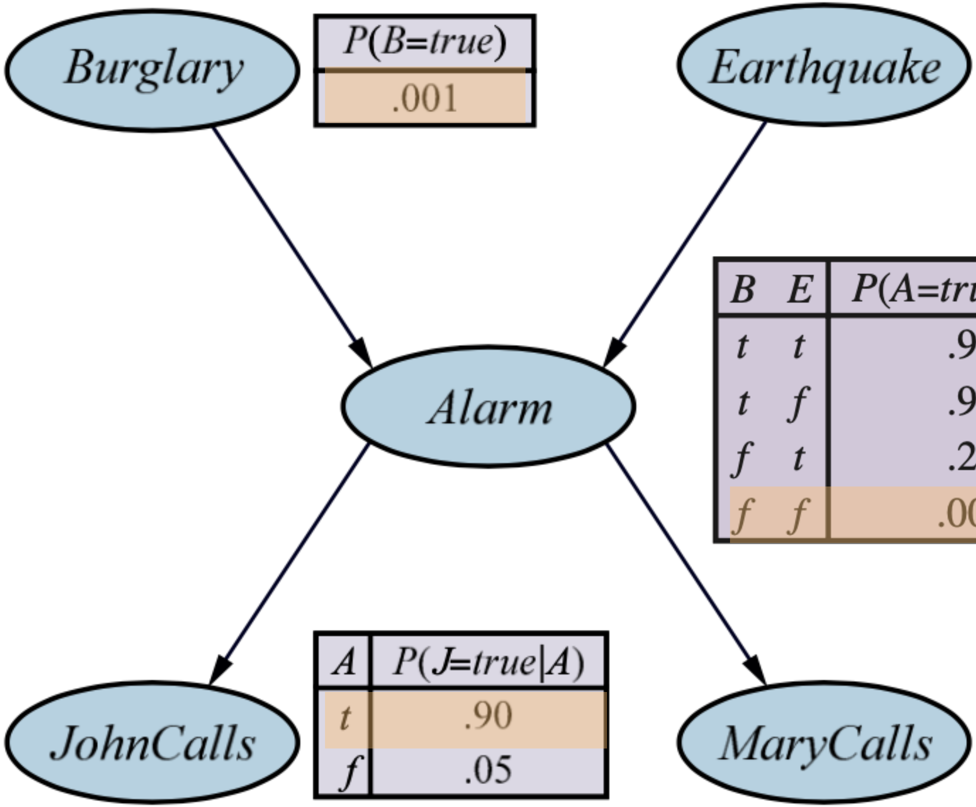
B	E	P(A=true|B,E)
t	t	.95
t	f	.94
f	t	.29
f	f	.001

A	P(J=true|A)
t	.90
f	.05

A	P(M=true|A)
t	.70
f	.01

Example

$$P(x_1, \ldots, x_n) = \prod_{i=1}^{n} P(x_i | parents(X_i))$$



P(B=true)
.001

P(E=true)
.002

B	E	P(A=true|B,E)
t	t	.95
t	f	.94
f	t	.29
f	f	.001

A	P(J=true|A)
t	.90
f	.05

A	P(M=true|A)
t	.70
f	.01

$$P(j, m, a, \neg b, \neg e)$$

$$= P(j|a)P(m|a)P(a|\neg b \wedge \neg e)P(\neg b)P(\neg e)$$

$$= 0.90 \times 0.70 \times 0.001 \times 0.999 \times 0.998 = 0.000628$$

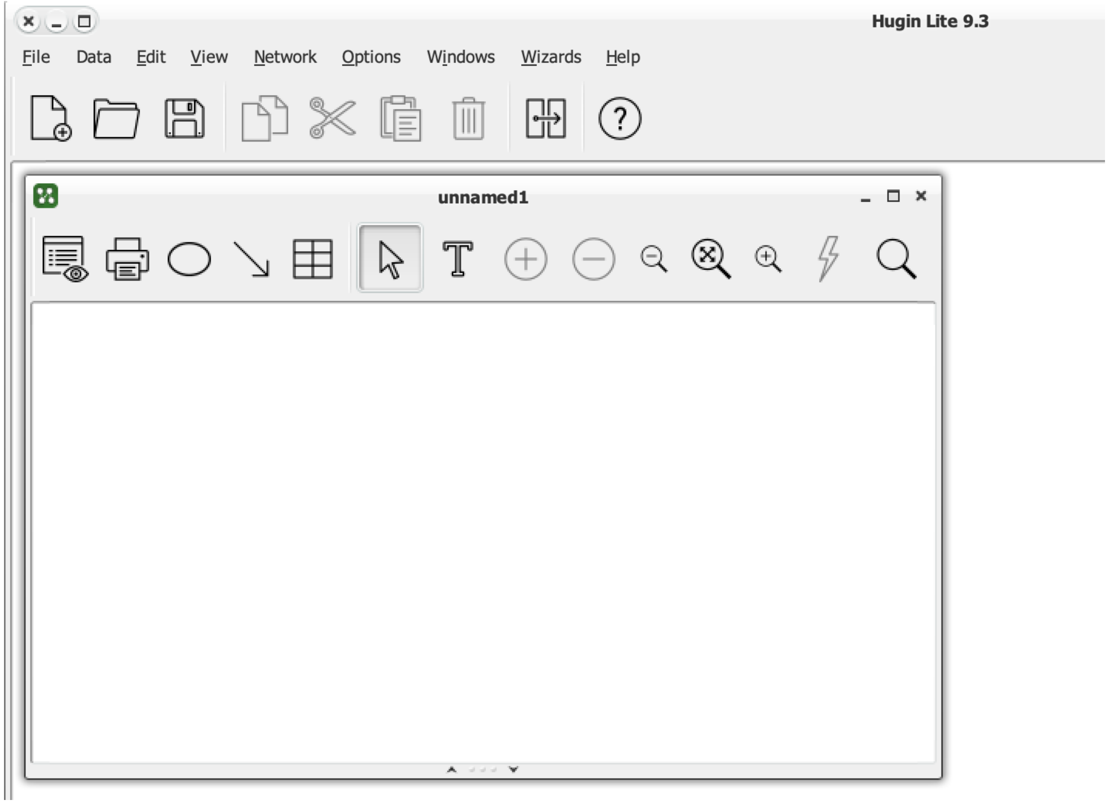
Inference in Bayes Net

- Exact inference (AIMA Ch 13.3)
  - Efficient approaches
- Approximate inference (AIMA Ch 13.4)

Sampling
- Prior
- Rejection
- Likelihood-weighted
- Gibbs

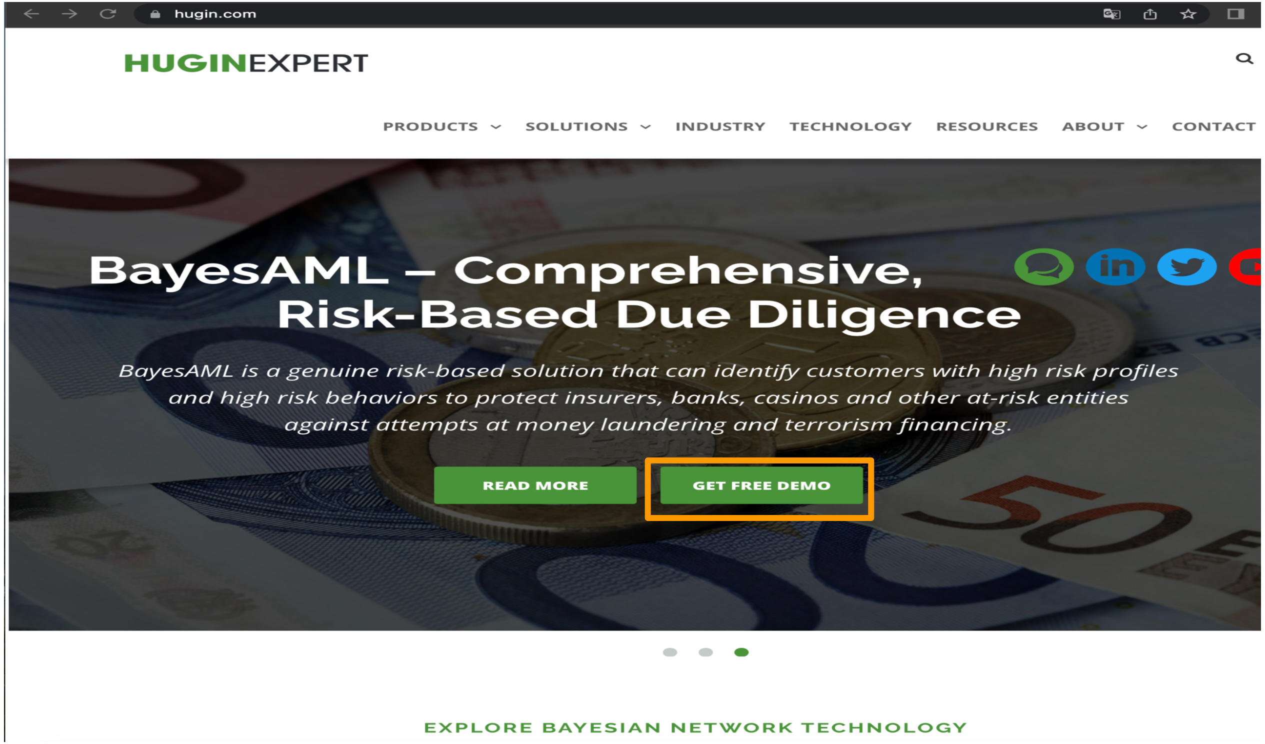
variable elimination (choose the one that creates the smallest factor ⇒ choosing the order of elimination is NP-Hard)

HUGINEXPERT: Bayes Net Software



HUGINEXPERT: Bayes Net Software

- Hugin Lite (https://www.hugin.com/)



Inference in Bayes Net

P(b) = 0.001

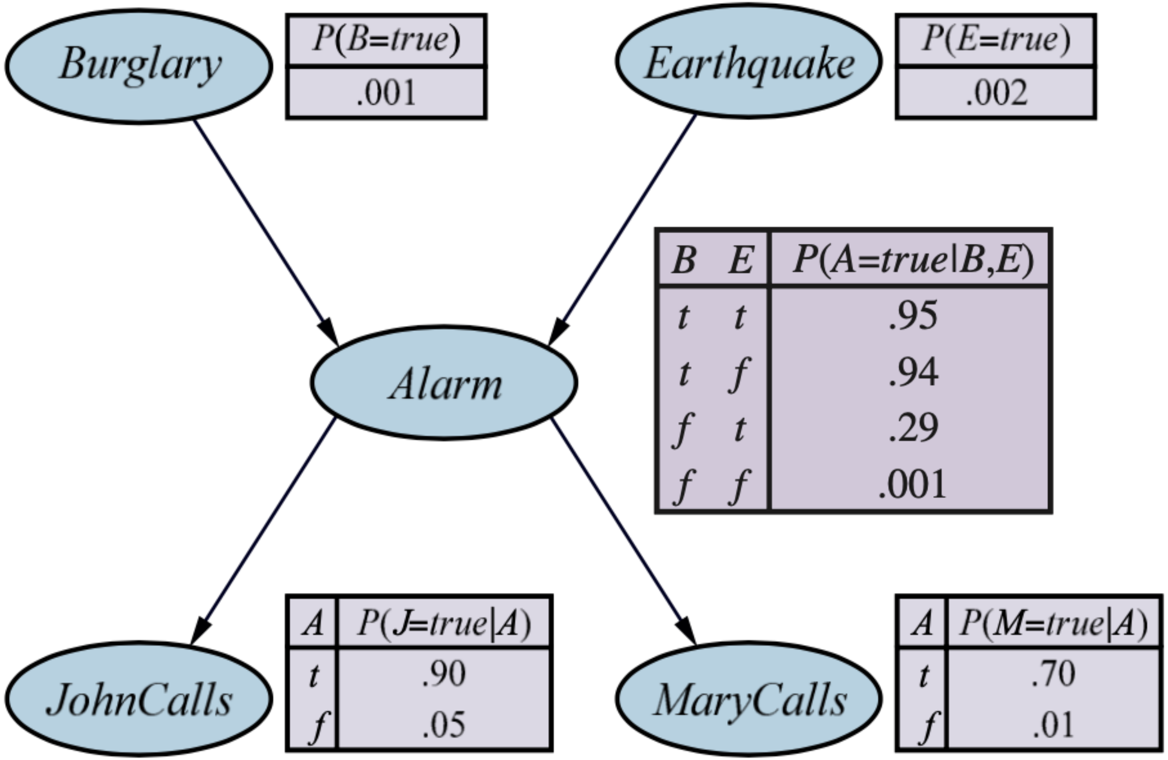
P(b | j) = ?

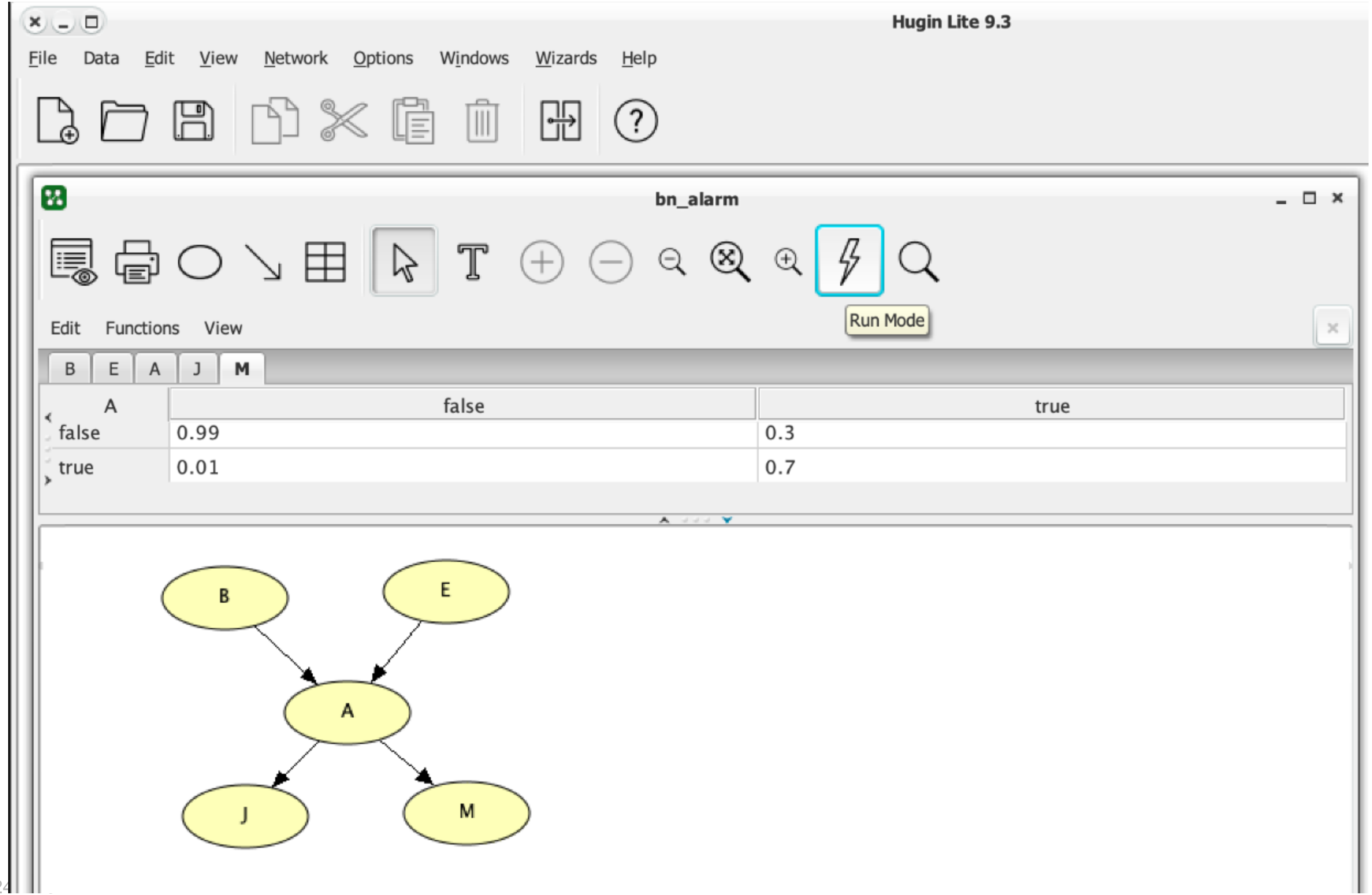
P(b | m) =?

P(b | j,m) =?

P(b | j,¬m) =?

P(b | j,m,¬e) =?

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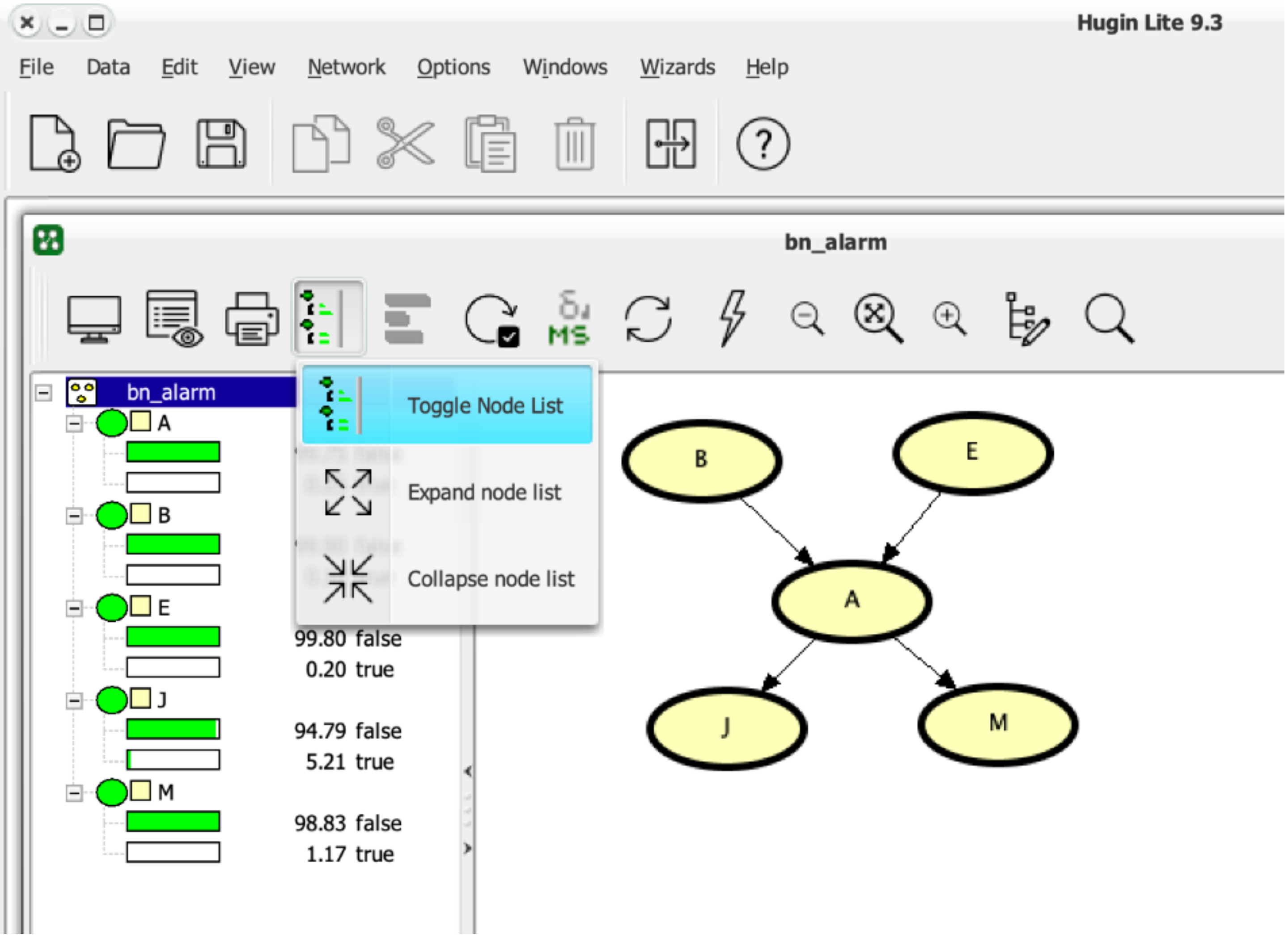
File Data Edit View Network Options Windows Wizards Help
bn_alarm
Run Mode
Edit Functions View
B E A J M
A false true
false 0.99 0.3
true 0.01 0.7
B
E
A
J
M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File
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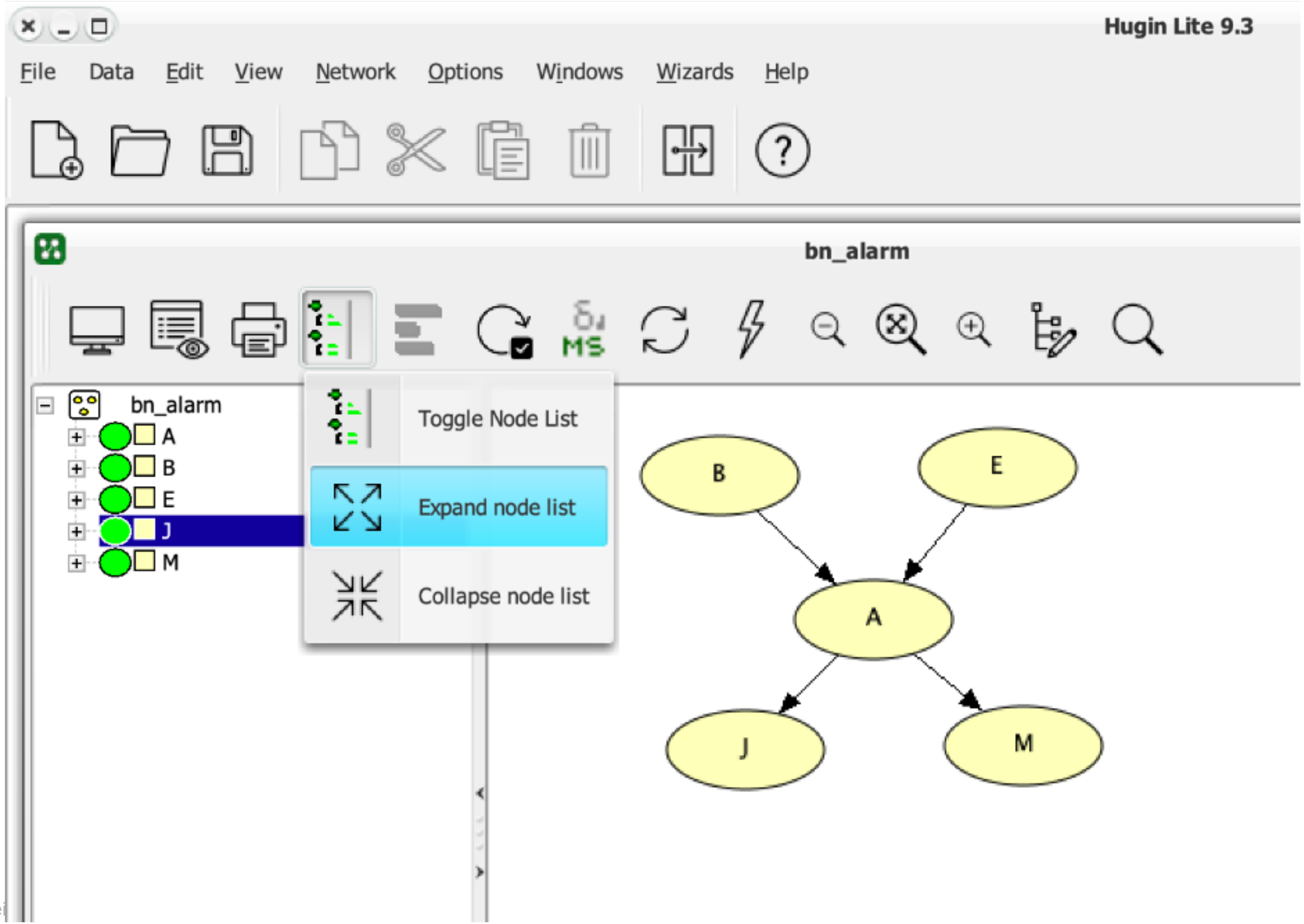
Options
Windows
Wizards
Help
bn_alarm
Toggle Node List
Expand node list
Collapse node list
bn_alarm
A
B
E
99.80 false
0.20 true
J
94.79 false
5.21 true
M
98.83 false
1.17 true
B
E
A
J
M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Toggle Node List
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Collapse node list
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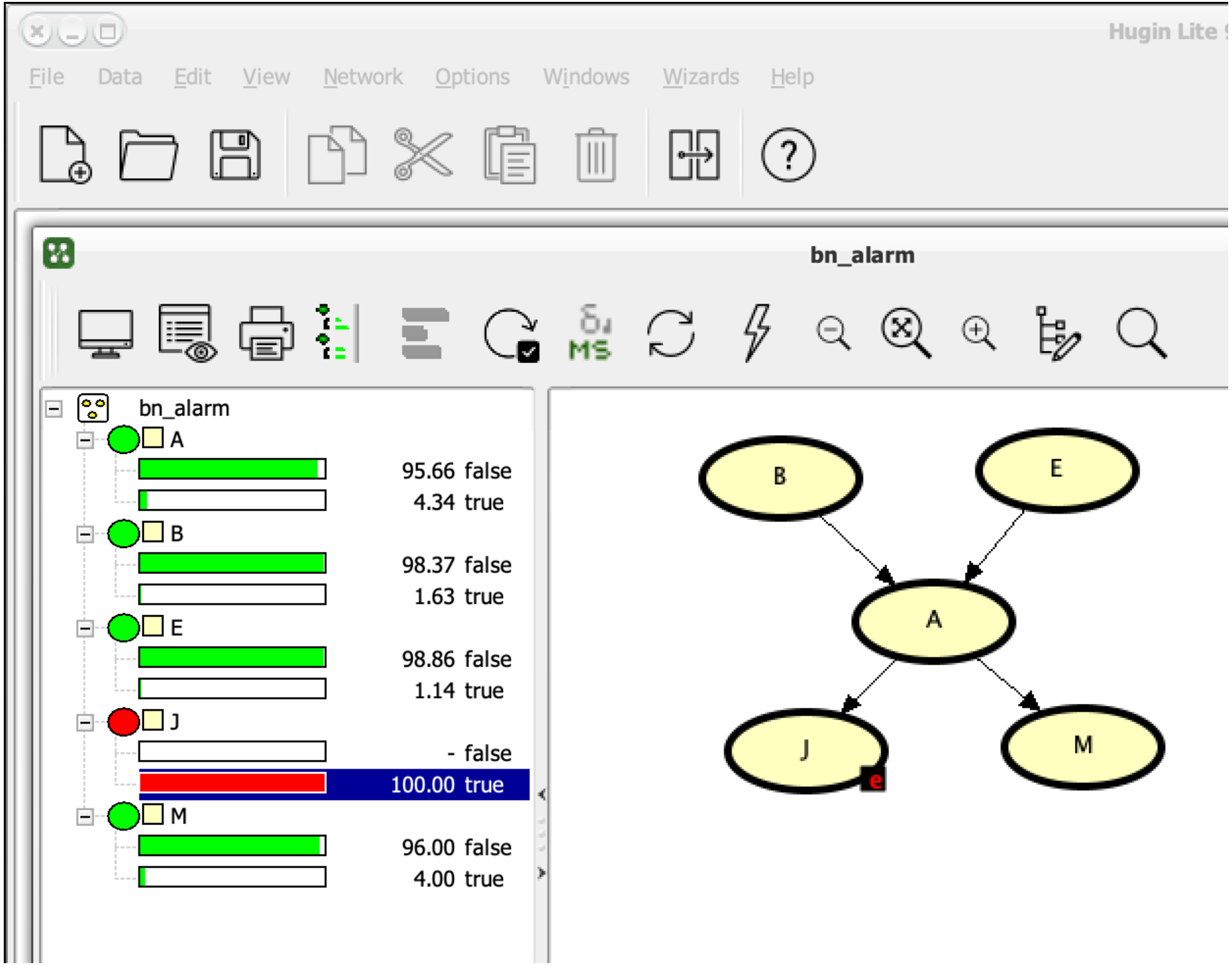
Hugin Lite
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Wizards
Help
bn_alarm
bn_alarm
A
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4.34 true
B
98.37 false
1.63 true
E
98.86 false
1.14 true
J
- false
100.00 true
M
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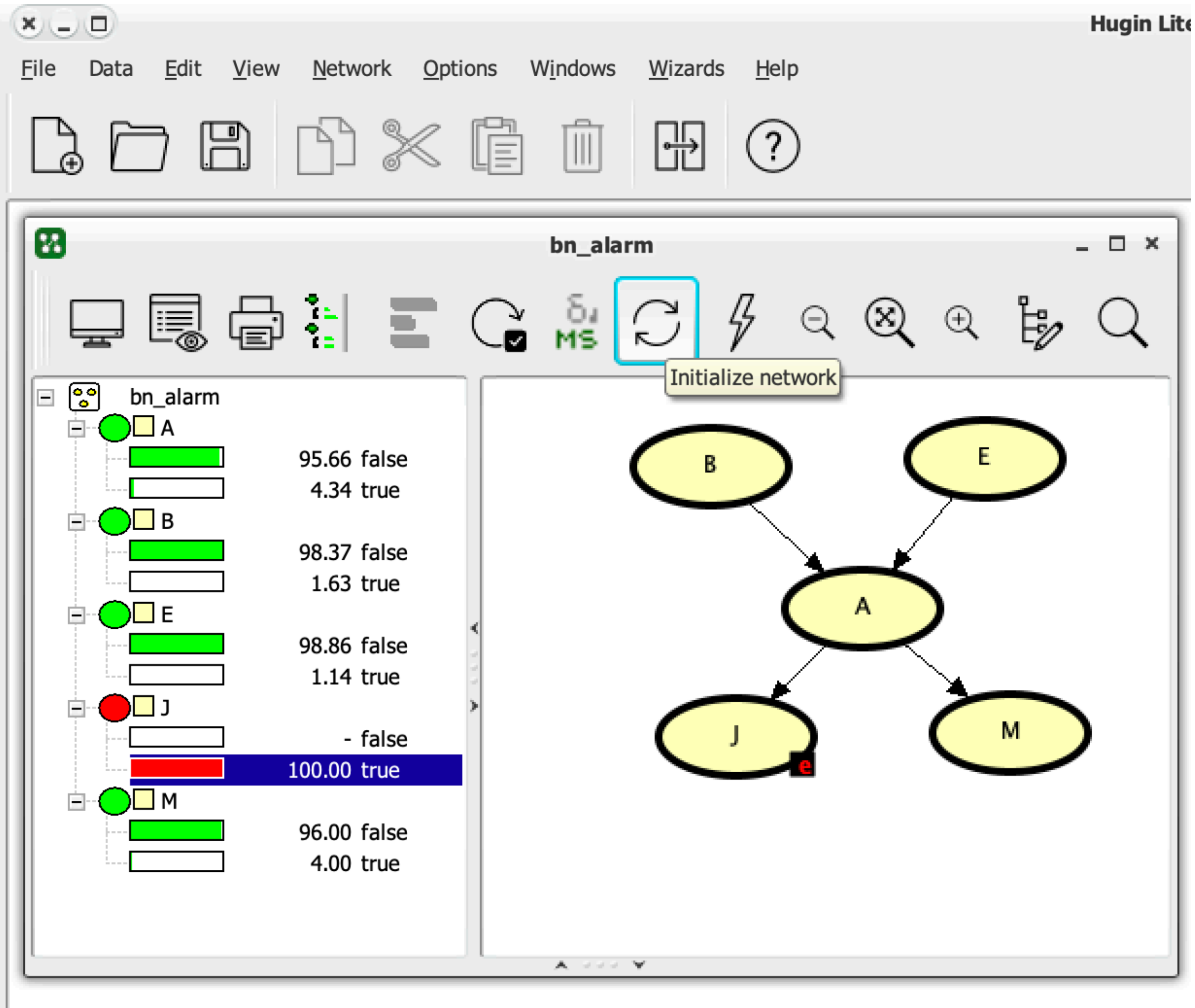
4.00 true
B
E
A
J
M
e


Hugin Lite
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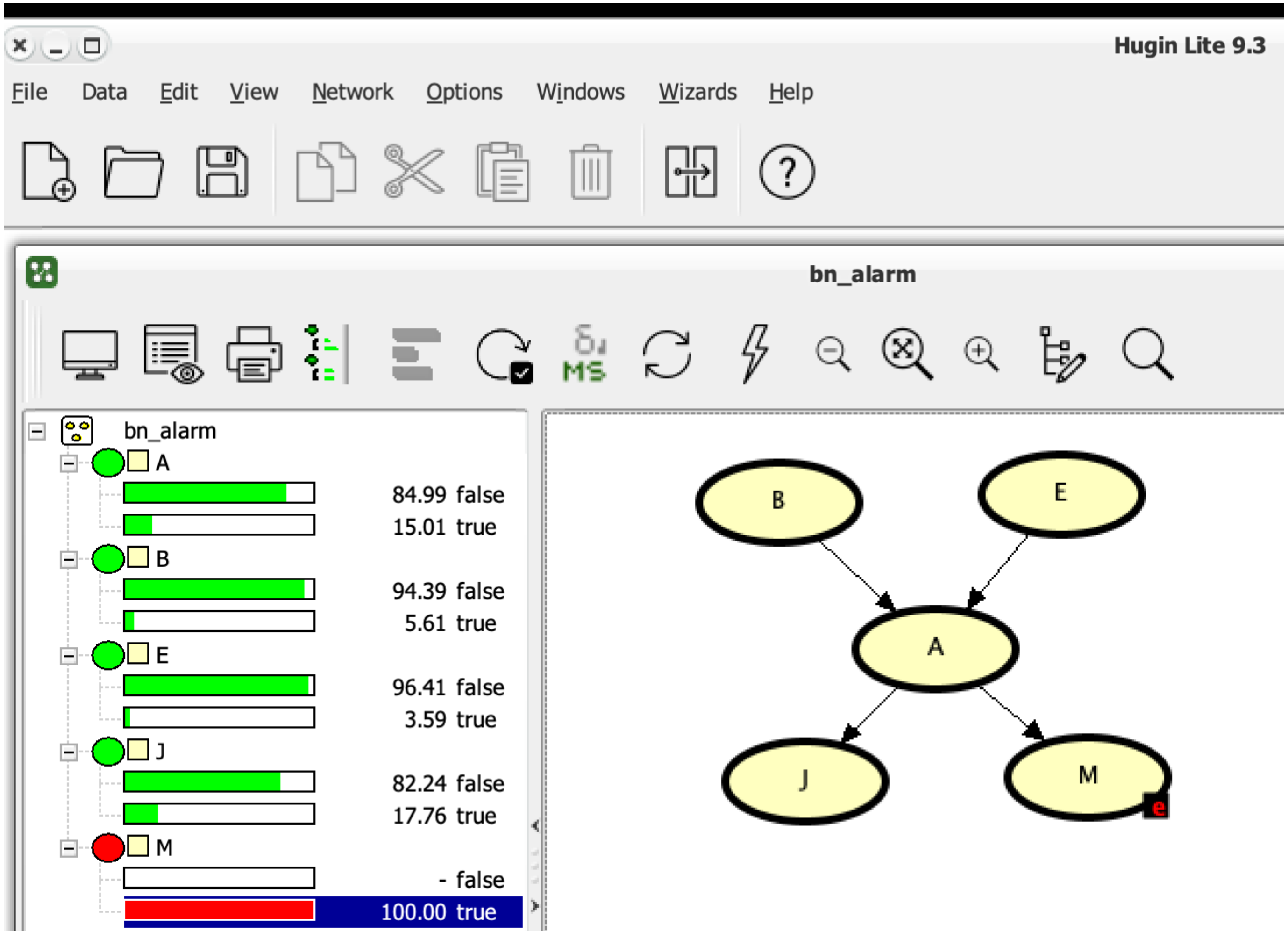
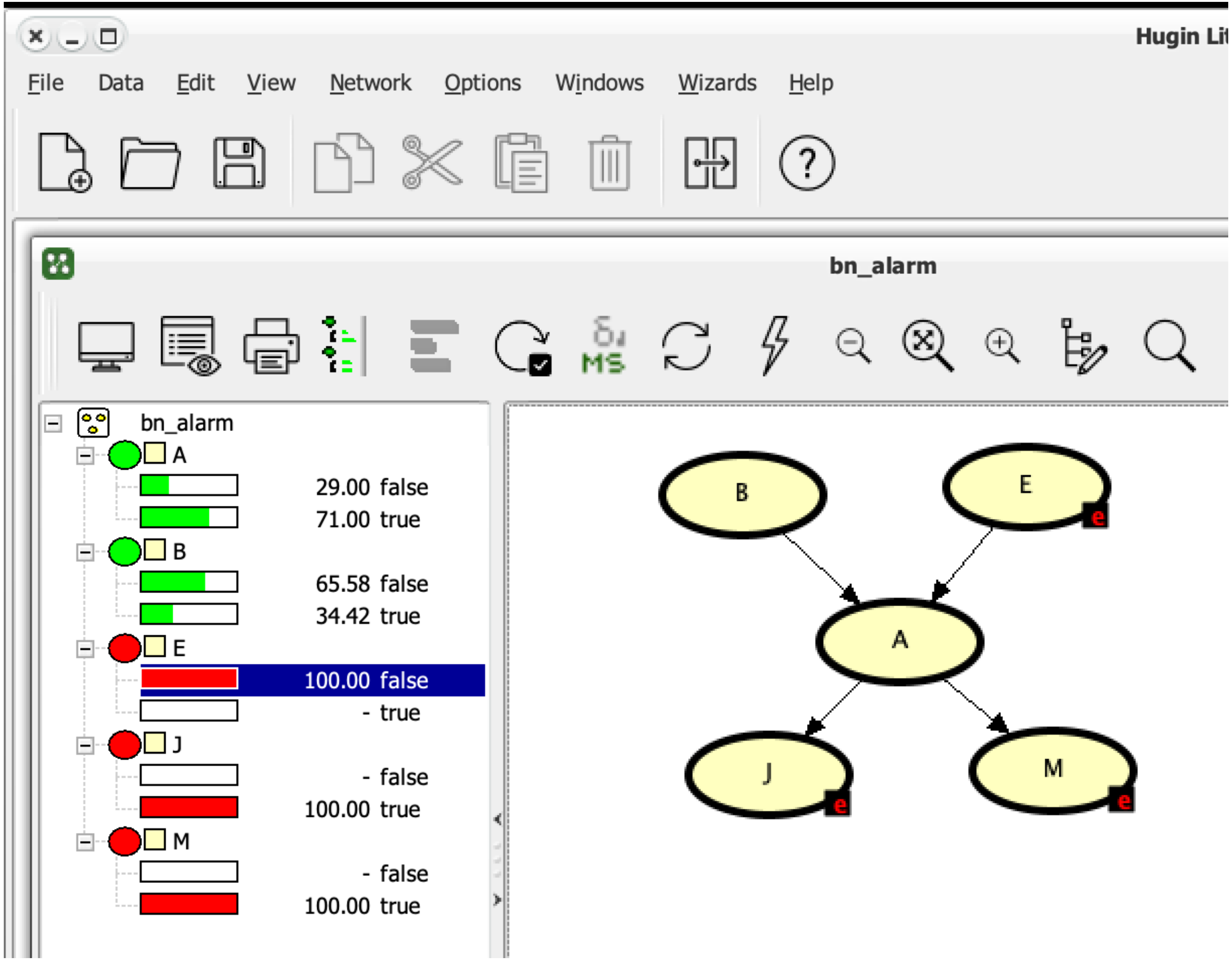
Network
Options
Windows
Wizards
Help
bn_alarm
Initialize network
bn_alarm
A
95.66 false
4.34 true
B
98.37 false
1.63 true
E
98.86 false
1.14 true
J
- false
100.00 true
M
96.00 false
4.00 true
B
E
A
J
M


Hugin Lite 9.3
File Data Edit View Network Options Windows Wizards Help
bn_alarm
MS
bn_alarm
A
84.99 false
15.01 true
B
94.39 false
5.61 true
E
96.41 false
3.59 true
J
82.24 false
17.76 true
M
- false
100.00 true
B
E
A
J
M
e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Wizards
Help
bn_alarm
bn_alarm
A
29.00 false
71.00 true
B
65.58 false
34.42 true
E
100.00 false
- true
J
- false
100.00 true
M
- false
100.00 true
B
E
A
J
M
e
e
e

Inference in Bayes Net

P(b) = 0.001

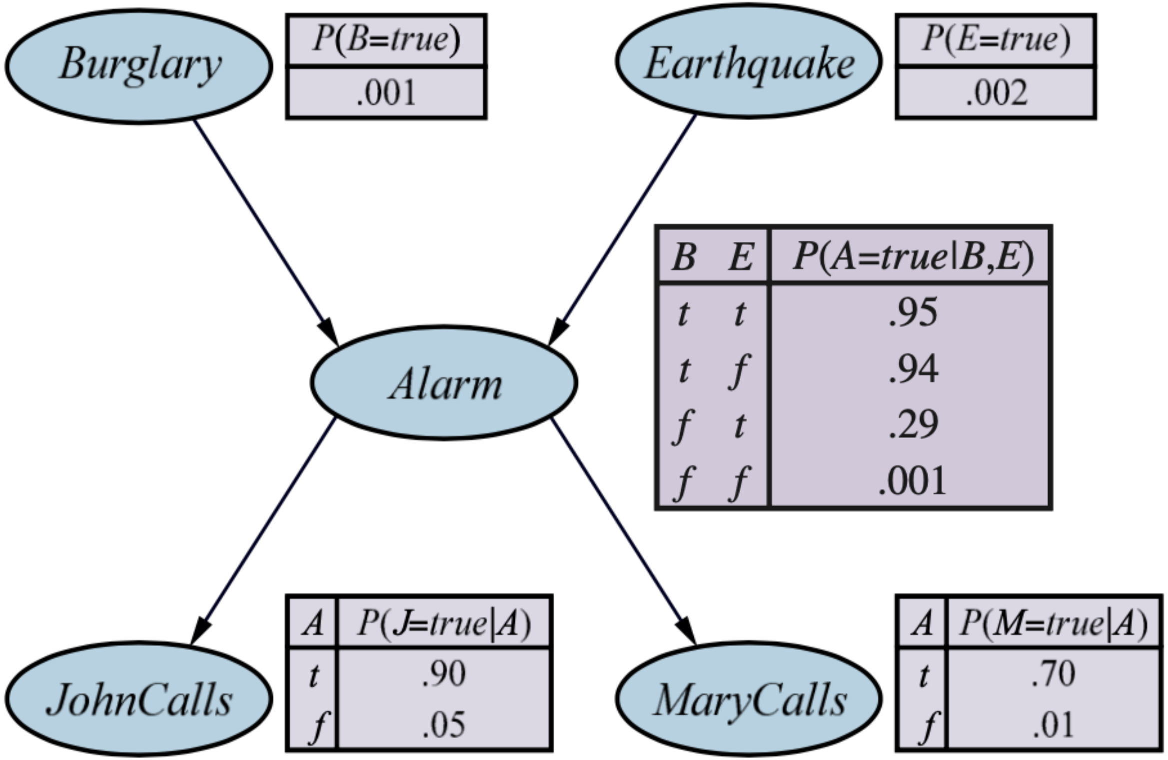
P(b | j) = ? 0.0163

P(b | m) =? 0.0561

P(b | j,m) =? 0.2842

P(b | j,¬m) =? 0.0051

P(b | j,m,¬e) =? 0.3442



Toy Example (in HW3)

- Variables and domains
  - **D**isease: {covid-19, flu, cold}
  - Symptoms:
    - **R**unning nose: {true, false}
    - **F**ever: {true, false}
    - **C**ough: {true, false}
- Questions
  - Patient 1: running nose and fever
    - P(covid-19 |r, f) = ?
  - Patient 2: cough
    - P(covid-19 |c) = ?
    - P(flu |c) = ?
    - P(cold |c) = ?

P(D=covid-19) = 0.2
P(D=flu) = 0.3
P(D=cold) = 0.5

P(r |covid-19) =0.6
P(r |flu) =0.4
P(r |cold) =0.5

P(f |covid-19) =0.8
P(f |flu) =0.3
P(f |cold) =0.2

P(c |covid-19) =0.6
P(c |flu) =0.2
P(c |cold) =0.4