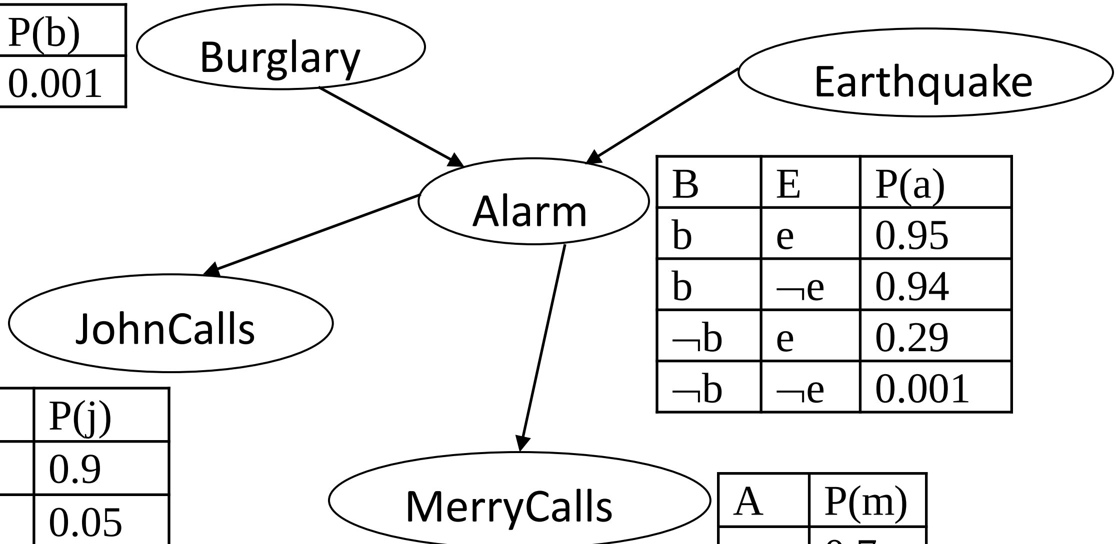
C. Another example of Bayesian Networks



P(b)
0.001

P(e)
0.002

B	E	P(a)
b	e	0.95
b	¬e	0.94
¬b	e	0.29
¬b	¬e	0.001

A	P(j)
a	0.9
¬a	0.05

A	P(m)
a	0.7
¬a	0.01

B	b	¬b
E	e	¬e
A	a	¬a
J	j	¬j
M	m	¬m

- **Making inference using the joint probabilities in the network:**

i) $P(a \wedge \neg j \wedge m \wedge \neg b \wedge e) = P(a \mid \neg b \wedge e) * P(\neg j \mid a) * P(m \mid a) * P(\neg b) * P(e)$

$= 0.29 * 0.1 * 0.7 * 0.999 * 0.002 = \ldots$

ii) Joint probabilities of any combination of the values of the random variables can be computed. Suppose, we need to compute

$P(b \mid a \wedge j \wedge m)$, $P(\neg b \mid a \wedge j \wedge m)$ and $P(e \mid a \wedge j \wedge m)$, $P(\neg e \mid a \wedge j \wedge m)$.

- $P(b \mid a \wedge j \wedge m) = P(b \wedge a \wedge j \wedge m) / P(a \wedge j \wedge m)$
- $P(b \wedge a \wedge j \wedge m) = P(b \wedge a \wedge j \wedge m \wedge e) + P(b \wedge a \wedge j \wedge m \wedge \neg e)$
- $P(a \wedge j \wedge m) = P(a \wedge j \wedge m \wedge b \wedge e) + P(a \wedge j \wedge m \wedge b \wedge \neg e) +$
  $P(a \wedge j \wedge m \wedge \neg b \wedge e) + P(a \wedge j \wedge m \wedge \neg b \wedge \neg e)$

➢ **Verify yourselves:**

$P(a \wedge j \wedge m \wedge b \wedge e) = 0.0000012$ $\quad$ $P(a \wedge j \wedge m \wedge b \wedge \neg e) = 0.0005910$

$P(a \wedge j \wedge m \wedge \neg b \wedge e) = 0.0003650$ $\quad$ $P(a \wedge j \wedge m \wedge \neg b \wedge \neg e) = 0.0006281$

✓ $P(B \mid a \wedge j \wedge m) = \langle P(b \mid a \wedge j \wedge m), P(\neg b \mid a \wedge j \wedge m) \rangle = \langle 37\%, 63\% \rangle$

✓ $P(E \mid a \wedge j \wedge m) = \langle P(e \mid a \wedge j \wedge m), P(\neg e \mid a \wedge j \wedge m) \rangle = \langle 23\%, 77\% \rangle$

D. Purpose of a Bayesian Network

1) A BN provides a complete and useful description of the domain.

2) It is as powerful as full joint-probability distribution.

3) It is significantly easier to specify.

4) It is human like and less costly: Only dependence of some variables from some other specific ones, not all, is considered.