

CS2810 Day 25

Admin:

- HW9 Problem 4.iii has solution in assignment pdf ... won't be graded (HW out of 90 points)

15 mins on Bayes Net Algebra & ICA

Mini Project 2

- submission instructions
- jupyter notebook (super quickly)
 - adding a picture via html link
 - adding a markdown table

How do we compute conditional probabilities from a Bayes Net?

With a computer:

Step 1: Rewrite conditional probability without conditional

Step 2(c): In a spreadsheet, compute prob of every possible combination of outputs for all vars

Step 3(c): Computer the needed probabilities from step 1 via marginalization

With algebra:

Step 1: Rewrite conditional probability without conditional

Step 2(a): rewrite each conditional probability using only probabilities given in Bayes Net

- add variables via marginalization

$$P(A) = \sum_b P(A, b)$$

- factor joint distributions into given conditional probabilities:

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

- utilize given independence relationships between variables

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

Step 3(a): plug in values

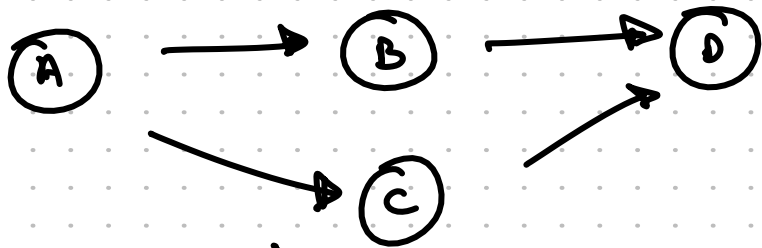
NEXT
LESSON

CONDITIONAL INDEP: ALGEBRA



$$\begin{aligned} P(A B C) &= P(C|BA) P(BA) \\ &= P(C|BA) P(B|A) P(A) \end{aligned}$$

CONDITIONAL INDEP: ALGEBRA



$$\begin{aligned} P(A B C D) &= P(D | A B C) P(A B C) \\ &= P(D | A B C) P(B C | A) P(A) \end{aligned}$$

MARGINALIZING IN BAYES NET



$$P(C_0) =$$

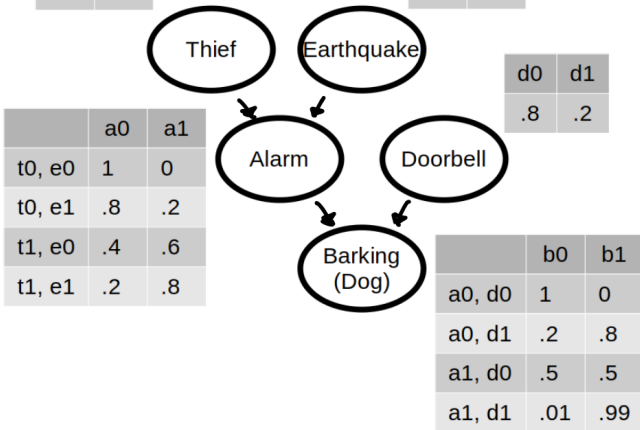
COMPUTE

$P(a_0)$

(PROB ALARM IS OFF)

t0	t1
.99	.01

e0	e1
.95	.05



d0	d1
.8	.2

	a0	a1
t0, e0	1	0
t0, e1	.8	.2
t1, e0	.4	.6
t1, e1	.2	.8

	b0	b1
a0, d0	1	0
a0, d1	.2	.8
a1, d0	.5	.5
a1, d1	.01	.99

$$P(a_0) = \sum_{t,e} P(a_0 | t, e)$$

$$= P(a_0 | t_0, e_0) P(t_0) P(e_0)$$

$$+ P(a_0 | t_0, e_1) P(t_0) P(e_1)$$

$$+ P(a_0 | t_1, e_0) P(t_1) P(e_0)$$

$$+ P(a_0 | t_1, e_1) P(t_1) P(e_1)$$

$$= 1 \cdot (.99) \cdot (.95) + .8 \cdot (.99) \cdot (.05) + .4 \cdot (.01) \cdot (.95) + .2 \cdot (.01) \cdot (.05) = .984$$

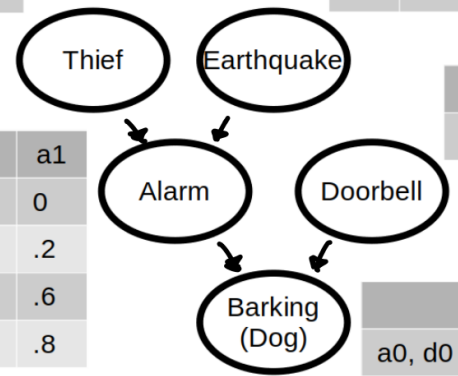
t0	t1
.99	.01

e0	e1
.95	.05

	a0	a1
t0, e0	1	0
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a0, d0	1	0
a0, d1	.2	.8
a1, d0	.5	.5
a1, d1	.01	.99

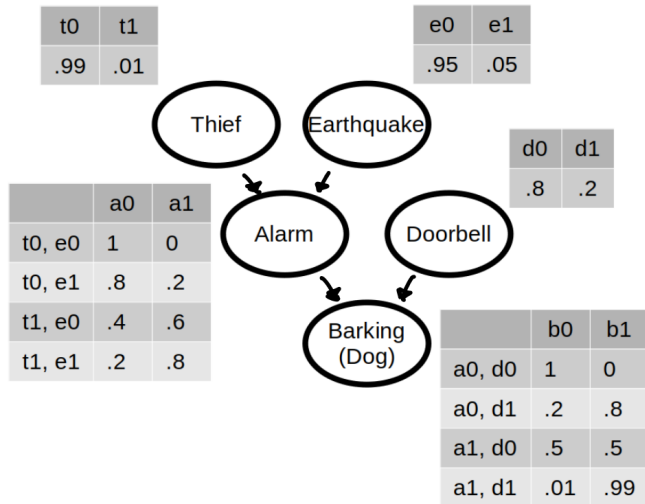


ICA 1

COMPUTE

$P(b_0)$

PROB DOG NOT BARKING



ANSWER ON NEXT PAGE ... DON'T PEAK!

Skip

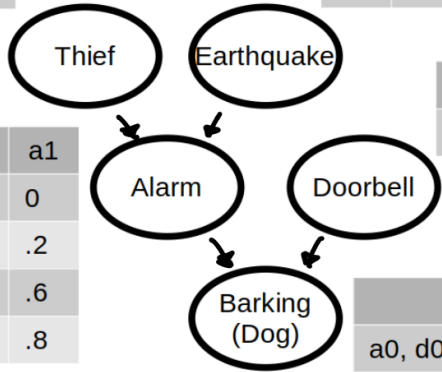
$$\begin{aligned}
 P(b_0) &= \sum_{a,d} P(b_0, a, d) \\
 &= P(b_0 | a_0, d_0) P(a_0) P(d_0) \\
 &+ P(b_0 | a_0, d_1) P(a_0) P(d_1) \\
 &+ P(b_0 | a_1, d_0) P(a_1) P(d_0) \\
 &+ P(b_0 | a_1, d_1) P(a_1) P(d_1)
 \end{aligned}$$

t0	t1
.99	.01

e0	e1
.95	.05

	a0	a1
t0, e0	1	0
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t1, e1	.2	.8

d0	d1
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	b0	b1
a0, d0	1	0
a0, d1	.2	.8
a1, d0	.5	.5
a1, d1	.01	.99

$$\begin{aligned}
 &= 1 \cdot (.984) \cdot (.8) \quad (.2) \cdot (.984) \cdot (.2) \\
 &+ (.5) \cdot (.016) \cdot (.8) \quad (.01) \cdot (.016) \cdot (.2) = .833
 \end{aligned}$$

EXTRA: NOT ON HW OR QUIZ

TOPOLOGICAL SORT OF DIRECTED GRAPH

ORDER NODES SO THAT IF EDGE x, y EXISTS THEN x IS IN LIST BEFORE y



A, B, C IS TOPO SORTED

WE MUST ADD NODES
IN BAYES NET IN
TOPO ORDERING

A, C, B IS NOT TOPO SORTED