

Baysen Network Report

CSE 5290

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Description:

Knowledge Base 1 has 3 root variables instead of 2, it has $P(B)$, $P(E)$, and $P(C)$. The variables B and E form the truth table that results in A . Variables B and C form the truth table that creates D . Variable A , formed by B and E , creates the truth table that creates J . Knowledge base 1, like the example, is an alarm system with a third base condition, variable C . C is a condition that could indicate a positive alarm, but more than likely is a false condition. The three queries are $P(A|D=t)$, $P(C|A=t)$, and $P(D|B=t)$. Some tested queries were too large to include in screen shots and had to be removed in favor of other ones.

Knowledge Base 2 has 2 root variables, $P(B)$ and $P(E)$. The truth table composed from B and E results in variables A . The result of variable A varies depends on the T/F states of B and E . Then variable A results in variable J . The result of variable J depends on the two states of A . Finally, variables A and J result in variable G . Variable G results on the states of variables A . Knowledge base 2 is also an example of an alarm system. Variables B and E are the base calculations and the result, G , is the probability of the severity of the burglary which increases the importance of alarm that is going off. The three queries that ran on this knowledge base were $P(J|E=t)$, $P(A|B=t)$, and $P(G|E=t)$. There were larger queries which our program handled easily however the result was too large to include in the requested screenshots.

Knowledge Base 3 has 2 root variables, $P(U)$ and $P(I)$. U indicates the chance of a client to leave dissatisfied and I indicates the chance for staff to make a mistake. B indicates the chance for the customer to leave a poor review. K indicates the chance for a bad review to impact another potential client's decision to visit the store, and N indicates the chance for the bad review to impact another current client's decision to not come back. The three queries are $P(B|I=t)$, $P(K|U=t)$, $P(N|U=t)$.

All queries were completed using the enumeration ask algorithm, as displayed below.

```
Choose file name or press 1 for default file, alarm.bn, or 2 for secondary file, custom.bn
kb1.bn
Choose enum or elim
enum
Enter a query or press 1 for default query P(J|M=t)
P(A|D=t)
J          | D=t A=f B=t C=t E=t   = 1.00000000
A J        | D=t A=f B=t C=t E=t   = 0.05000000
J          | D=t A=f B=t C=t E=f   = 1.00000000
```

Test Cases:

Knowledge Base 1:

$$P(B) = .001$$

$$P(E) = .002$$

$$P(C) = .004$$

B	E	A
t	t	.95
t	f	.94
f	t	.29
f	f	.001

B	C	D
t	t	.25
t	f	.48
f	t	.02
f	f	.001

A	J
t	0.90
f	0.05

Knowledge Base 2:

$$P(B) = .001$$

$$P(E) = .002$$

B	E	A
t	t	.95
t	f	.94
f	t	.29
f	f	.001

A	J
t	0.90
f	0.05

A	J	G
t	t	.16
t	f	.29
f	t	.4
f	f	.73

Knowledge Base 3:

$$P(U) = .08$$

$$P(I) = .04$$

U	I	B
t	t	.75
t	f	.21
f	t	.20
f	f	.05

B	K
t	0.89
f	0.04

B	N
t	0.4
f	0.32

Knowledge Base 1:

Query 1: $P(A|D=t)$

J	D=t A=f B=t C=t E=t	= 1.00000000
A J	D=t A=f B=t C=t E=t	= 0.05000000
J	D=t A=f B=t C=t E=f	= 1.00000000
A J	D=t A=f B=t C=t E=f	= 0.06000000
E A J	D=t A=f B=t C=t	= 0.05998000
D E A J	D=t A=f B=t C=t	= 0.01499500
J	D=t A=f B=t C=f E=t	= 1.00000000
A J	D=t A=f B=t C=f E=t	= 0.05000000
J	D=t A=f B=t C=f E=f	= 1.00000000
A J	D=t A=f B=t C=f E=f	= 0.06000000
E A J	D=t A=f B=t C=f	= 0.05998000
D E A J	D=t A=f B=t C=f	= 0.02879040
C D E A J	D=t A=f B=t	= 0.02873522
J	D=t A=f B=f C=t E=t	= 1.00000000
A J	D=t A=f B=f C=t E=t	= 0.71000000
J	D=t A=f B=f C=t E=f	= 1.00000000
A J	D=t A=f B=f C=t E=f	= 0.99900000
E A J	D=t A=f B=f C=t	= 0.99842200
D E A J	D=t A=f B=f C=t	= 0.01996844
J	D=t A=f B=f C=f E=t	= 1.00000000
A J	D=t A=f B=f C=f E=t	= 0.71000000
J	D=t A=f B=f C=f E=f	= 1.00000000
A J	D=t A=f B=f C=f E=f	= 0.99900000
E A J	D=t A=f B=f C=f	= 0.99842200
D E A J	D=t A=f B=f C=f	= 0.00099842
C D E A J	D=t A=f B=f	= 0.00107430
B C D E A J	D=t A=f	= 0.00110196
J	D=t A=t B=t C=t E=t	= 1.00000000
A J	D=t A=t B=t C=t E=t	= 0.95000000
J	D=t A=t B=t C=t E=f	= 1.00000000
A J	D=t A=t B=t C=t E=f	= 0.94000000
E A J	D=t A=t B=t C=t	= 0.94002000
D E A J	D=t A=t B=t C=t	= 0.23500500
J	D=t A=t B=t C=f E=t	= 1.00000000
A J	D=t A=t B=t C=f E=t	= 0.95000000
J	D=t A=t B=t C=f E=f	= 1.00000000
A J	D=t A=t B=t C=f E=f	= 0.94000000
E A J	D=t A=t B=t C=f	= 0.94002000
D E A J	D=t A=t B=t C=f	= 0.45120960
C D E A J	D=t A=t B=t	= 0.45034478
J	D=t A=t B=f C=t E=t	= 1.00000000
A J	D=t A=t B=f C=t E=t	= 0.29000000
J	D=t A=t B=f C=t E=f	= 1.00000000
A J	D=t A=t B=f C=t E=f	= 0.00100000
E A J	D=t A=t B=f C=t	= 0.00157800
D E A J	D=t A=t B=f C=t	= 0.00003156
J	D=t A=t B=f C=f E=t	= 1.00000000
A J	D=t A=t B=f C=f E=t	= 0.29000000
J	D=t A=t B=f C=f E=f	= 1.00000000
A J	D=t A=t B=f C=f E=f	= 0.00100000
E A J	D=t A=t B=f C=f	= 0.00157800
D E A J	D=t A=t B=f C=f	= 0.00000158
C D E A J	D=t A=t B=f	= 0.00000170
B C D E A J	D=t A=t	= 0.00045204

RESULT:
 $P(A = f \mid D = t) = 0.7091$
 $P(A = t \mid D = t) = 0.2909$

Query 2: $P(C|A=t)$

J	A=t C=f B=t D=t E=t	= 1.00000000
A J	A=t C=f B=t D=t E=t	= 0.95000000
J	A=t C=f B=t D=t E=f	= 1.00000000
A J	A=t C=f B=t D=t E=f	= 0.94000000
E A J	A=t C=f B=t D=t	= 0.94002000
J	A=t C=f B=t D=f E=t	= 1.00000000
A J	A=t C=f B=t D=f E=t	= 0.95000000
J	A=t C=f B=t D=f E=f	= 1.00000000
A J	A=t C=f B=t D=f E=f	= 0.94000000
E A J	A=t C=f B=t D=f	= 0.94002000
D E A J	A=t C=f B=t	= 0.94002000
C D E A J	A=t C=f B=t	= 0.93625992
J	A=t C=f B=f D=t E=t	= 1.00000000
A J	A=t C=f B=f D=t E=t	= 0.29000000
J	A=t C=f B=f D=t E=f	= 1.00000000
A J	A=t C=f B=f D=t E=f	= 0.00100000
E A J	A=t C=f B=f D=t	= 0.00157800
J	A=t C=f B=f D=f E=t	= 1.00000000
A J	A=t C=f B=f D=f E=t	= 0.29000000
J	A=t C=f B=f D=f E=f	= 1.00000000
A J	A=t C=f B=f D=f E=f	= 0.00100000
E A J	A=t C=f B=f D=f	= 0.00157800
D E A J	A=t C=f B=f	= 0.00157800
C D E A J	A=t C=f B=f	= 0.00157169
B C D E A J	A=t C=f	= 0.00250638
J	A=t C=t B=t D=t E=t	= 1.00000000
A J	A=t C=t B=t D=t E=t	= 0.95000000
J	A=t C=t B=t D=t E=f	= 1.00000000
A J	A=t C=t B=t D=t E=f	= 0.94000000
E A J	A=t C=t B=t D=t	= 0.94002000
J	A=t C=t B=t D=f E=t	= 1.00000000
A J	A=t C=t B=t D=f E=t	= 0.95000000
J	A=t C=t B=t D=f E=f	= 1.00000000
A J	A=t C=t B=t D=f E=f	= 0.94000000
E A J	A=t C=t B=t D=f	= 0.94002000
D E A J	A=t C=t B=t	= 0.94002000
C D E A J	A=t C=t B=t	= 0.00376008
J	A=t C=t B=f D=t E=t	= 1.00000000
A J	A=t C=t B=f D=t E=t	= 0.29000000
J	A=t C=t B=f D=t E=f	= 1.00000000
A J	A=t C=t B=f D=t E=f	= 0.00100000
E A J	A=t C=t B=f D=t	= 0.00157800
J	A=t C=t B=f D=f E=t	= 1.00000000
A J	A=t C=t B=f D=f E=t	= 0.29000000
J	A=t C=t B=f D=f E=f	= 1.00000000
A J	A=t C=t B=f D=f E=f	= 0.00100000
E A J	A=t C=t B=f D=f	= 0.00157800
D E A J	A=t C=t B=f	= 0.00157800
C D E A J	A=t C=t B=f	= 0.00000631
B C D E A J	A=t C=t	= 0.00001007

RESULT:
 $P(C = f \mid A = t) = 0.9960$
 $P(C = t \mid A = t) = 0.0040$

Query 3: $P(D|B=t)$

J	B=t D=f C=t E=t A=t	= 1.00000000
J	B=t D=f C=t E=t A=f	= 1.00000000
A J	B=t D=f C=t E=t	= 1.00000000
J	B=t D=f C=t E=f A=t	= 1.00000000
J	B=t D=f C=t E=f A=f	= 1.00000000
A J	B=t D=f C=t E=f	= 1.00000000
E A J	B=t D=f C=t	= 1.00000000
D E A J	B=t D=f C=t	= 0.75000000
J	B=t D=f C=f E=t A=t	= 1.00000000
J	B=t D=f C=f E=t A=f	= 1.00000000
A J	B=t D=f C=f E=t	= 1.00000000
J	B=t D=f C=f E=f A=t	= 1.00000000
J	B=t D=f C=f E=f A=f	= 1.00000000
A J	B=t D=f C=f E=f	= 1.00000000
E A J	B=t D=f C=f	= 1.00000000
D E A J	B=t D=f C=f	= 0.52000000
C D E A J	B=t D=f	= 0.52092000
B C D E A J	B=t D=f	= 0.00052092
J	B=t D=t C=t E=t A=t	= 1.00000000
J	B=t D=t C=t E=t A=f	= 1.00000000
A J	B=t D=t C=t E=t	= 1.00000000
J	B=t D=t C=t E=f A=t	= 1.00000000
J	B=t D=t C=t E=f A=f	= 1.00000000
A J	B=t D=t C=t E=f	= 1.00000000
E A J	B=t D=t C=t	= 1.00000000
D E A J	B=t D=t C=t	= 0.25000000
J	B=t D=t C=f E=t A=t	= 1.00000000
J	B=t D=t C=f E=t A=f	= 1.00000000
A J	B=t D=t C=f E=t	= 1.00000000
J	B=t D=t C=f E=f A=t	= 1.00000000
J	B=t D=t C=f E=f A=f	= 1.00000000
A J	B=t D=t C=f E=f	= 1.00000000
E A J	B=t D=t C=f	= 1.00000000
D E A J	B=t D=t C=f	= 0.48000000
C D E A J	B=t D=t	= 0.47908000
B C D E A J	B=t D=t	= 0.00047908

RESULT:

$P(D = f \mid B = t) = 0.5209$

$P(D = t \mid B = t) = 0.4791$

Knowledge Base 2:

Query 1: $P(J|E=t)$

G	E=t j=f B=t A=t J=t	= 1.00000000
G	E=t j=f B=t A=t J=f	= 1.00000000
J G	E=t j=f B=t A=t	= 1.00000000
G	E=t j=f B=t A=f J=t	= 1.00000000
G	E=t j=f B=t A=f J=f	= 1.00000000
J G	E=t j=f B=t A=f	= 1.00000000
A J G	E=t j=f B=t	= 1.00000000
E A J G	E=t j=f B=t	= 0.00200000
G	E=t j=f B=f A=t J=t	= 1.00000000
G	E=t j=f B=f A=t J=f	= 1.00000000
J G	E=t j=f B=f A=t	= 1.00000000
G	E=t j=f B=f A=f J=t	= 1.00000000
G	E=t j=f B=f A=f J=f	= 1.00000000
J G	E=t j=f B=f A=f	= 1.00000000
A J G	E=t j=f B=f	= 1.00000000
E A J G	E=t j=f B=f	= 0.00200000
B E A J G	E=t j=f	= 0.00200000
G	E=t j=t B=t A=t J=t	= 1.00000000
G	E=t j=t B=t A=t J=f	= 1.00000000
J G	E=t j=t B=t A=t	= 1.00000000
G	E=t j=t B=t A=f J=t	= 1.00000000
G	E=t j=t B=t A=f J=f	= 1.00000000
J G	E=t j=t B=t A=f	= 1.00000000
A J G	E=t j=t B=t	= 1.00000000
E A J G	E=t j=t B=t	= 0.00200000
G	E=t j=t B=f A=t J=t	= 1.00000000
G	E=t j=t B=f A=t J=f	= 1.00000000
J G	E=t j=t B=f A=t	= 1.00000000
G	E=t j=t B=f A=f J=t	= 1.00000000
G	E=t j=t B=f A=f J=f	= 1.00000000
J G	E=t j=t B=f A=f	= 1.00000000
A J G	E=t j=t B=f	= 1.00000000
E A J G	E=t j=t B=f	= 0.00200000
B E A J G	E=t j=t	= 0.00200000

RESULT:

$P(j = f \mid E = t) = 0.5000$
 $P(j = t \mid E = t) = 0.5000$

Query 2: $P(A|B=t)$

G	B=t A=f E=t J=t	= 1.00000000
G	B=t A=f E=t J=f	= 1.00000000
J G	B=t A=f E=t	= 1.00000000
A J G	B=t A=f E=t	= 0.05000000
G	B=t A=f E=f J=t	= 1.00000000
G	B=t A=f E=f J=f	= 1.00000000
J G	B=t A=f E=f	= 1.00000000
A J G	B=t A=f E=f	= 0.06000000
E A J G	B=t A=f	= 0.05998000
B E A J G	B=t A=f	= 0.00005998
G	B=t A=t E=t J=t	= 1.00000000
G	B=t A=t E=t J=f	= 1.00000000
J G	B=t A=t E=t	= 1.00000000
A J G	B=t A=t E=t	= 0.95000000
G	B=t A=t E=f J=t	= 1.00000000
G	B=t A=t E=f J=f	= 1.00000000
J G	B=t A=t E=f	= 1.00000000
A J G	B=t A=t E=f	= 0.94000000
E A J G	B=t A=t	= 0.94002000
B E A J G	B=t A=t	= 0.00094002

RESULT:

$P(A = f \mid B = t) = 0.0600$
 $P(A = t \mid B = t) = 0.9400$

Query 3: $P(G|E=t)$

G	E=t G=f B=t A=t J=t	= 0.84000000
G	E=t G=f B=t A=t J=f	= 0.71000000
J G	E=t G=f B=t A=t	= 0.82700000
G	E=t G=f B=t A=f J=t	= 0.60000000
G	E=t G=f B=t A=f J=f	= 0.27000000
J G	E=t G=f B=t A=f	= 0.28650000
A J G	E=t G=f B=t	= 0.79997500
E A J G	E=t G=f B=t	= 0.00159995
G	E=t G=f B=f A=t J=t	= 0.84000000
G	E=t G=f B=f A=t J=f	= 0.71000000
J G	E=t G=f B=f A=t	= 0.82700000
G	E=t G=f B=f A=f J=t	= 0.60000000
G	E=t G=f B=f A=f J=f	= 0.27000000
J G	E=t G=f B=f A=f	= 0.28650000
A J G	E=t G=f B=f	= 0.44324500
E A J G	E=t G=f B=f	= 0.00088649
B E A J G	E=t G=f	= 0.00088720
G	E=t G=t B=t A=t J=t	= 0.16000000
G	E=t G=t B=t A=t J=f	= 0.29000000
J G	E=t G=t B=t A=t	= 0.17300000
G	E=t G=t B=t A=f J=t	= 0.40000000
G	E=t G=t B=t A=f J=f	= 0.73000000
J G	E=t G=t B=t A=f	= 0.71350000
A J G	E=t G=t B=t	= 0.20002500
E A J G	E=t G=t B=t	= 0.00040005
G	E=t G=t B=f A=t J=t	= 0.16000000
G	E=t G=t B=f A=t J=f	= 0.29000000
J G	E=t G=t B=f A=t	= 0.17300000
G	E=t G=t B=f A=f J=t	= 0.40000000
G	E=t G=t B=f A=f J=f	= 0.73000000
J G	E=t G=t B=f A=f	= 0.71350000
A J G	E=t G=t B=f	= 0.55675500
E A J G	E=t G=t B=f	= 0.00111351
B E A J G	E=t G=t	= 0.00111280

RESULT:

$P(G = f \mid E = t) = 0.4436$

$P(G = t \mid E = t) = 0.5564$

Knowledge Base 3:

Query 1: $P(B|I=t)$

N	I=t B=f U=t K=t	= 1.00000000
N	I=t B=f U=t K=f	= 1.00000000
K N	I=t B=f U=t	= 1.00000000
B K N	I=t B=f U=t	= 0.25000000
N	I=t B=f U=f K=t	= 1.00000000
N	I=t B=f U=f K=f	= 1.00000000
K N	I=t B=f U=f	= 1.00000000
B K N	I=t B=f U=f	= 0.80000000
U B K N	I=t B=f	= 0.75600000
I U B K N	I=t B=f	= 0.03024000
N	I=t B=t U=t K=t	= 1.00000000
N	I=t B=t U=t K=f	= 1.00000000
K N	I=t B=t U=t	= 1.00000000
B K N	I=t B=t U=t	= 0.75000000
N	I=t B=t U=f K=t	= 1.00000000
N	I=t B=t U=f K=f	= 1.00000000
K N	I=t B=t U=f	= 1.00000000
B K N	I=t B=t U=f	= 0.20000000
U B K N	I=t B=t	= 0.24400000
I U B K N	I=t B=t	= 0.00976000
RESULT:		
$P(B = f \mid I = t) = 0.7560$		
$P(B = t \mid I = t) = 0.2440$		

Query 2: $P(K|U=t)$

N	U=t K=f I=t B=t	= 1.00000000
K N	U=t K=f I=t B=t	= 0.11000000
N	U=t K=f I=t B=f	= 1.00000000
K N	U=t K=f I=t B=f	= 0.96000000
B K N	U=t K=f I=t	= 0.32250000
U B K N	U=t K=f I=t	= 0.02580000
N	U=t K=f I=f B=t	= 1.00000000
K N	U=t K=f I=f B=t	= 0.11000000
N	U=t K=f I=f B=f	= 1.00000000
K N	U=t K=f I=f B=f	= 0.96000000
B K N	U=t K=f I=f	= 0.78150000
U B K N	U=t K=f I=f	= 0.06252000
I U B K N	U=t K=f	= 0.06105120
N	U=t K=t I=t B=t	= 1.00000000
K N	U=t K=t I=t B=t	= 0.89000000
N	U=t K=t I=t B=f	= 1.00000000
K N	U=t K=t I=t B=f	= 0.04000000
B K N	U=t K=t I=t	= 0.67750000
U B K N	U=t K=t I=t	= 0.05420000
N	U=t K=t I=f B=t	= 1.00000000
K N	U=t K=t I=f B=t	= 0.89000000
N	U=t K=t I=f B=f	= 1.00000000
K N	U=t K=t I=f B=f	= 0.04000000
B K N	U=t K=t I=f	= 0.21850000
U B K N	U=t K=t I=f	= 0.01748000
I U B K N	U=t K=t	= 0.01894880
RESULT:		
$P(K = f \mid U = t) = 0.7631$		
$P(K = t \mid U = t) = 0.2369$		

Query 3: $P(N|U=t)$

N	U=t N=f I=t B=t K=t	= 0.60000000
N	U=t N=f I=t B=t K=f	= 0.60000000
K N	U=t N=f I=t B=t	= 0.60000000
N	U=t N=f I=t B=f K=t	= 0.68000000
N	U=t N=f I=t B=f K=f	= 0.68000000
K N	U=t N=f I=t B=f	= 0.68000000
B K N	U=t N=f I=t	= 0.62000000
U B K N	U=t N=f I=t	= 0.04960000
N	U=t N=f I=f B=t K=t	= 0.60000000
N	U=t N=f I=f B=t K=f	= 0.60000000
K N	U=t N=f I=f B=t	= 0.60000000
N	U=t N=f I=f B=f K=t	= 0.68000000
N	U=t N=f I=f B=f K=f	= 0.68000000
K N	U=t N=f I=f B=f	= 0.68000000
B K N	U=t N=f I=f	= 0.66320000
U B K N	U=t N=f I=f	= 0.05305600
I U B K N	U=t N=f	= 0.05291776
N	U=t N=t I=t B=t K=t	= 0.40000000
N	U=t N=t I=t B=t K=f	= 0.40000000
K N	U=t N=t I=t B=t	= 0.40000000
N	U=t N=t I=t B=f K=t	= 0.32000000
N	U=t N=t I=t B=f K=f	= 0.32000000
K N	U=t N=t I=t B=f	= 0.32000000
B K N	U=t N=t I=t	= 0.38000000
U B K N	U=t N=t I=t	= 0.03040000
N	U=t N=t I=f B=t K=t	= 0.40000000
N	U=t N=t I=f B=t K=f	= 0.40000000
K N	U=t N=t I=f B=t	= 0.40000000
N	U=t N=t I=f B=f K=t	= 0.32000000
N	U=t N=t I=f B=f K=f	= 0.32000000
K N	U=t N=t I=f B=f	= 0.32000000
B K N	U=t N=t I=f	= 0.33680000
U B K N	U=t N=t I=f	= 0.02694400
I U B K N	U=t N=t	= 0.02708224

RESULT:

$P(N = f \mid U = t) = 0.6615$

$P(N = t \mid U = t) = 0.3385$