Name : Kalpana Pratapaneni
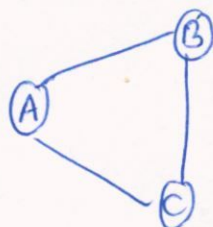
A# : A20448916

collabarators :
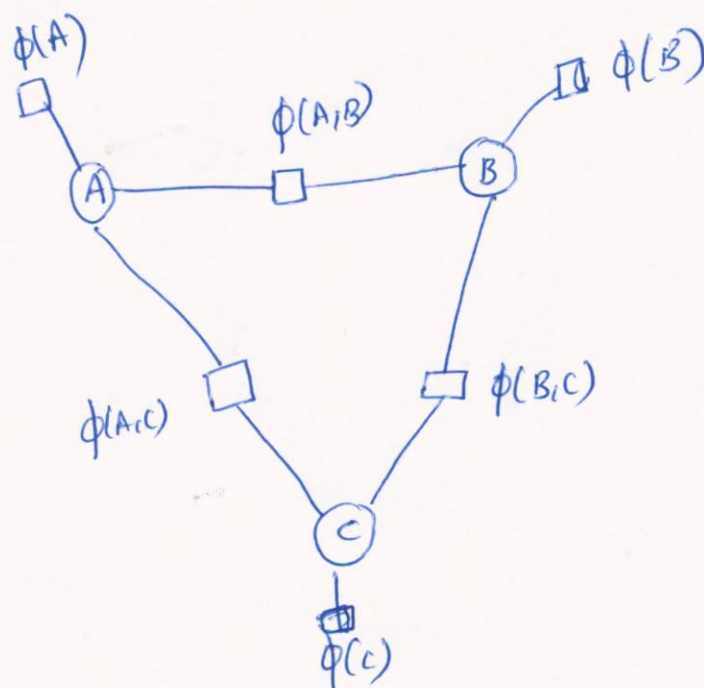
Tusher (A20444211)

Jasmith (A20438656)

(i)

(a)

(b)

$\phi(A)$, $\phi(B)$, $\phi(A,B)$, $\phi(A,C)$, $\phi(B,C)$, $\phi(C)$

(c) $\dfrac{1}{Z}\ \phi(A)\ \phi(B)\ \phi(C)\ \phi(A,B)\ \phi(B,C)\ \phi(C,A)$ — markov network to calculate $P(A,B,C)$

A	B	C	$\phi(A)\phi(B)\phi(A,B)\phi(B,C)\phi(C,A)$							P(A,B,C) (Normalize)
T	T	T	2 *	1 *	1 *	5 *	1 *	6 = 60		0.02
T	T	F	2 *	1 *	8 *	5 *	10 *	1 = 800		0.26
T	F	T	2 *	4 *	1 *	1 *	10 *	6 = 480		0.16
T	F	F	2 *	4 *	8 *	1 *	1 *	1 = 64		0.02
F	T	T	1 *	1 *	1 *	1 *	1 *	1 = 1		0.0003
F	T	F	1 *	1 *	8 *	1 *	10 *	6 = 480		0.16
F	F	T	1 *	4 *	1 *	5 *	10 *	1 = 200		0.07
F	F	F	1 *	4 *	8 *	5 *	1 *	6 = 960		0.32

$$Z = \overline{3045}$$

(2)

a) $A \perp B$ false

b) $A \perp B \mid C$ True

c) $A \perp G \mid D$ False

d) $A \perp G \mid D, F$ True

e) $A \perp H \mid G$ True

③

X_i	Y_i	$f_1(x_{1i}, y_j)$	$f_2(x_{1i}, y_i)$
True	Al	1	0
True	DB	0	1
False	Al	0	0
False	DB	0	0

X_{2i}	Y_i	$f_3(x_{2i}, y_i)$	$f_4(x_{2i}, y_i)$
True	Al	1	0
True	BB	0	1
False	AI	0	0
False	DB	0	0

Y_i	Y_j	$f_5(y_i, y_j)$	$f_6(y_i, y_j)$
Al	Al	1	0
Al	DB	0	1
DB	Al	0	1
DB	DB	1	0

Energy $\varepsilon = -\omega_1 f_1 - \omega_2 f_2$

$= -(-1) f_1 - (1) f_2$

$= f_1 - f_2$

$\phi_1(X_{1i}, Y_i) = e^{-(\omega_1 f_1 + \omega_2 f_2)}$

$= e^{f_1 - f_2}$

$\phi_1(T, A1) = e^{1-0} = 2.72$

$\phi_1(T, DB) = e^{-1} = 0.37$

$\phi_1(F, A1) = e^0 = 1$

$\phi_1(F, DB) = e^0 = 1$

Energy $\varepsilon = -\omega_3 f_3 - \omega_4 f_4$

$\phi_2(X_{2i}, Y_i) = e^{-((1) f_3 + (-1) f_4)}$

$= e^{-f_3 + f_4}$

$\phi_2(T, A1) = e^{-1+0} = 0.37$

$\phi_2(T, DB) = e^{-0+1} = 2.72$

$\phi_2(F, A1) = e^{-0+0} = e^0 = 1$

$\phi_2(F, DB) = e^{-0+0} = e^0 = 1$

$\phi_3(Y_i, Y_j) = e^{-(\omega_5 f_5 + \omega_6 f_6)}$

$= e^{-(-1 f_5 + 1 \cdot f_6)}$

$= e^{f_5 - f_6}$

$\phi_3(A1, A1) = e^{1-0} = e^1 = 2.72$
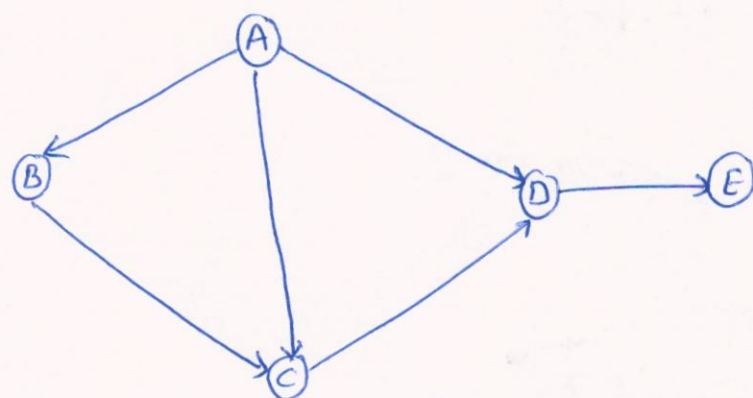
$\phi_3(A1, DB) = e^{0-1} = e^{-1} = 0.37$

$\phi_3(DB, A1) = e^{0-1} = 0.37$

$\phi_3(DB, DB) = e^{1-0} = 2.72$

X1i	Yi	φ1(X1i, Yi)
T	AI	2.72
T	DB	0.37
F	AI	1
F	DB	1

X2i	Yi	φ2(X2i, Yi)
T	AI	0.37
T	DB	2.72
F	AI	1
F	DB	1

Y1	Yi	φ3(X2i, Yi)
AI	AI	2.72
AI	DB	0.37
DB	AI	0.37
DB	DB	2.72

Y1	Y2	Y3	Y4	φ1(X11=T, Y1) φ1(X12=T, Y2) φ1(X13=F, Y3) φ1(X14=T, Y4) φ2(X21=F, Y1) φ2(X22=T, Y2) φ2(X23=T, Y3) φ2(X24=T, Y4) φ3(Y1, Y2) φ3(Y3, Y4)	P(Y1, Y2, Y3, Y4 | X11=T, X21=F, X12=T, X22=T, X13=F, X23=T, X14=T, X24=T)
AI	AI	AI	AI	7.541360335	0.08167224968
AI	AI	AI	DB	1.02584681	0.01110982808
AI	AI	DB	AI	7.541360335	0.08167224968
AI	**AI**	**DB**	**DB**	**55.43918949**	**0.600401403**
AI	DB	AI	AI	1.02584681	0.01110982808
AI	DB	AI	DB	0.1395453382	0.001511263379
AI	DB	DB	AI	1.02584681	0.01110982808
AI	DB	DB	DB	7.541360335	0.08167224968
DB	AI	AI	AI	0.1395453382	0.001511263379
DB	AI	AI	DB	0.01898227026	0.0002055762684
DB	AI	DB	AI	0.1395453382	0.001511263379
DB	AI	DB	DB	1.02584681	0.01110982808
DB	DB	AI	AI	1.02584681	0.01110982808
DB	DB	AI	DB	0.1395453382	0.001511263379
DB	DB	DB	AI	1.02584681	0.01110982808
DB	DB	DB	DB	7.541360335	0.08167224968
			Z=	92.33687531	1

MAP assignment to Y given X is: Y1=AI, Y2=AI, Y3=DB, Y4=DB with probability 0.600401403

④ⓐ Order: A, B, C, D, E

I-map

Step1: B⊥A ✗

Step2: C⊥A,B ✗

  C⊥A|B ✓

Step3: D⊥A,B,C ✗

  D⊥B|A,C ✓

Step4: E⊥A,B,C,D ✗

  E⊥A,B,C|D ✓

④ⓑ
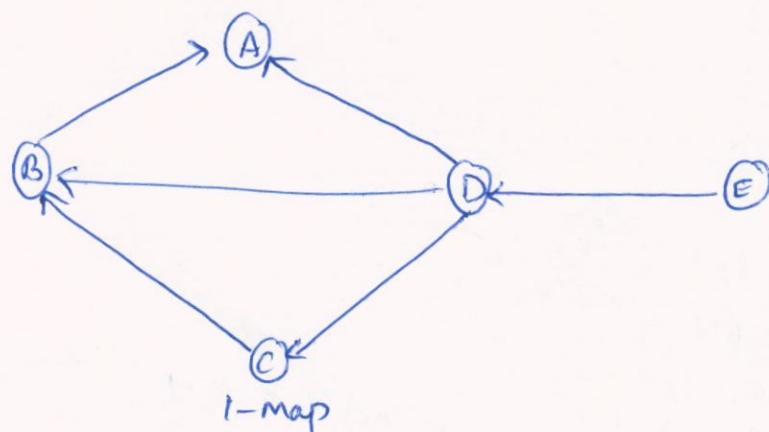
I-map

Order: E, D, C; B, A

Step4:

  A⊥B,C,D,E ✗

  A⊥C,E|B,D ✓

Step1: D⊥E ✗

Step2: C⊥D,E ✗

  C⊥E|D

Step3: B⊥C,D,E ✗

  B⊥D,E|C ✗

  B⊥E|C,D ✓

(4c) (Gii) It is not a perfect map.

Missing independency $A \perp C \mid B, D$ ✗

(4d) If G_2 is not a perfect map for H

Missing independencies:

$$B \perp E \mid A, C ✗$$
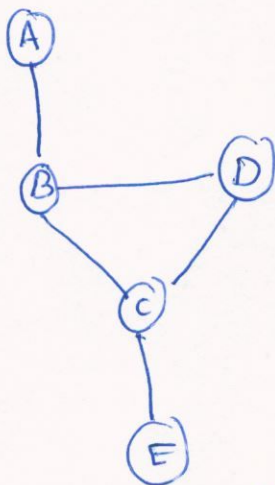$$B \perp E \mid C, D ✗$$
$$B \perp E \mid C ✗$$
$$B \perp E \mid A, D ✗$$

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(5)

(a)

Markov Network for the given BN

(6) H is a minimal I-Map but not P-map because of the below

BN missing dependency

$$B \perp D \mid C ✗$$
$$B \perp D ✗$$
$$A \perp D ✗$$
$$A \perp D \mid C ✗$$