DS8004 – Reasoning and Belief Propagation in Bayesian Networks

Student: NAJLIS, BERNARDO (#500744793)

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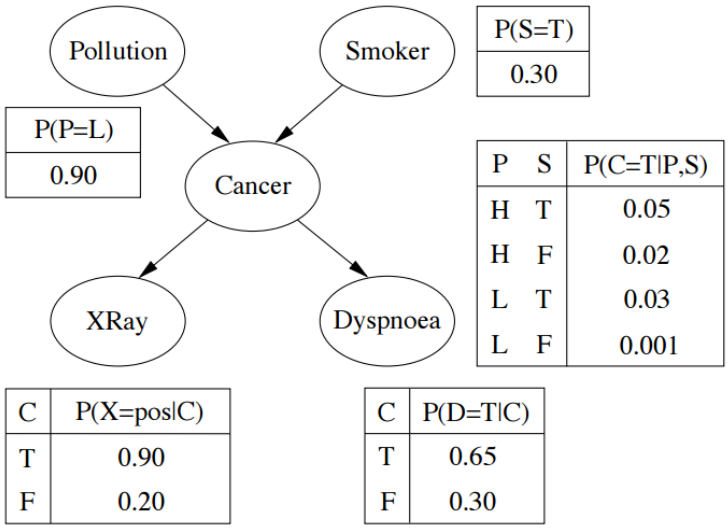

Node	No	Reasoning Case			
P(S)=0.3	Evidence	Diagnostic D=T	Predictive S=T	Intercausal C=T	Intercausal C=T S=T
Bel(P=high)	0.100	0.102	0.100	0.249	0.156
Bel(S=T)	0.300	0.307	1	0.825	1
Bel(C=T)	0.011	0.025	0.032	1	1
Bel(X=pos)	0.208	0.217	0.222	0.900	0.900
Bel(D=T)	0.304	1	0.311	0.650	0.650
P(S)=0.5					
Bel(P=high)	0.100	0.102	0.100	0.201	0.156
Bel(S=T)	0.500	0.508	1	0.917	1
Bel(C=T)	0.174	0.037	0.032	1	1
Bel(X=pos)	0.212	0.226	0.311	0.900	0.900
Bel(D=T)	0.306	1	0.222	0.650	0.650

Node P(S) = 0.3	No Evidence	Reasoning Case			
		Diagnostic D=T	Predictive S=T	Intercausal	
				C=T	C=T / S=T
Bel(P=H)	=1-P(L)=1-0.9=**0.1**	=P(P=H|D^T) = P(D=T|P^H) * P(P=H) / P(D=T) = (P(D=T|C^T) * P(C=T|P^H) + P(D=T|C^F) + P(C=F|P^H)) * P(P=H)) / P(D=T) =(0.65* (0.05 + 0.02)) + (0.3 * (1-0.05-0.02)) * 0.1) / 0.3040705 = **0.106719**	=1-P(L) = **0.1**	=P(P=H|C^T) = P(C|P^H)*P(P=H) / P(C) = P(C|P^T,S^T)*P(S) + P(C|P^T,S^F)*(1-P(S)) = (0.05 * 0.3 + 0.02 * 0.7) / 0.012 = **0.249**	=P(P=H|C^T,S^T)*P(P|S^T) /P(C|S^T) = P(C|S^T,P^T)*P(P=H) / (P(C|P^T,S^T)*P(P) + P(C|P^F,S^T)*(1-P(P))) = 0.05*0.1/(0.05*0.1 + 0.03 * 0.9) = **0.156**
Bel(S=T)	=P(S) = **0.3**		=**1**		=**1**
Bel(C=T)	=(P(C=T|P^H,S^T) * P(P=H) * P(S=T))+ (P(C=T|P^H,S^F) * P(P=H) * P(S=F))+ P(C=T|P^L,S^T) * P(P=L) * P(S=T) + P(C=T|P^L,S^F) * P(P=L) * P(S=F) = (0.05 * 0.1 * 0.3) + (0.02 * 0.1 * (1 - 0.3)) + (0.03 * 0.9 * 0.3) + (0.001 * 0.9 * (1 - 0.3)) = **0.01163**	=P(C=T|D^T) = P(D=T|C^T) * P(C=T) / (P(D=T|C^T) * P(C=T) + P(D=T|C^F) * (1 - P(C=T))) = 0.65 * 0.011 / (0.65 * 0.011 + 0.3 * (1-0.011) =**0.023531**	=P(C=T|S^T) = P(C|S^T,P^T)*P(P) + P(C|S^T,P^T)*P(P^T) + P(C|S^T,P^F) * P(P^F) = 0.05 * 0.1 + 0.03 * 0.9 = **0.032**	=**1**	=**1**
Bel(X=pos)	=P(X=pos|C^T)*P(C=T) + P(X=pos|C^F) * P(C=F) = 0.9 * 0.01163 + 0.2 * (1-0.01163) = **0.208141**	=P(X=pos|D=T)=P(X=pos|D^T,C^T)*P(C=T|D^T) + P(X=pos|D^T,C^F) * P(C=F|D^T) = P(X=pos|C^T)*(P(C=T|D^T) + P(X=pos|C^F) * P(C=F|D^T) = 0.9*0.025 + 0.2 * 0.974= 0.217	=P(X=pos|C^T) = P(X=pos|C^T)*P(C^T) + P(X=pos|C^F)*P(C^F)=0.9*0.032 + 0.2 * 0.968 = **0.211**	=P(X=pos|C^T) = P(X=pos|C^T)*P(C=T) = 0.9*1 = **0.9**	=P(X=post|C^T,S^T)=P(X=pos|C^T)*P(C=T) = 0.9*1 = **0.9**
Bel(D=T)	=P(D=T|C^T) * P(C=T)+ P(D=T|C^F) * P(C=F)= 0.65 * 0.01163 + 0.3 * (1-0.01163) = **0.3040705**	=P(D=T|D^T) = **1**	=P(D=T|C^T) = P(D=T|C^T)*P(C) | P(D=T|C^F) = 0.65*0.032 + 0.3 * 0.968 = **0.311**	=P(D=T|C^T) = P(D=T|C^T)*P(C=T) = 0.65*1 = **0.65**	=P(D=T|C^T,S^T)=P(D=T|C^T) * P(C=T) = 0.65*1 = **0.65**

Node P(S) = 0.5	No Evidence	Reasoning Case			
		Diagnostic D=T	Predictive S=T	Intercausal	
				C=T	C=T / S=T
Bel(P=H)	$=1-P(L)=1-0.9=\underline{\mathbf{0.1}}$	$=P(P=H\|D^T) = P(D=T\|P^H) * P(P=H) / P(D=T) = (P(D=T\|C^T) * P(C=T\|P^H) + P(D=T\|C^F) + P(C=F\|P^H)) * P(P=H)) / P(D=T) =(0.65* (0.05 + 0.02)) + (0.5 * (1-0.05-0.02)) * 0.1) / 0.3040705 = \underline{\mathbf{0.106719}}$	$=1-P(L) = \underline{\mathbf{0.1}}$	$=P(P=H\|C^T) = P(C\|P^H)*P(P=H) / P(C) = P(C\|P^T,S^T)*P(S) + P(C\|P^T,S^F)*(1-P(S)) = (0.05 * 0.5 + 0.02 * 0.5) / 0.012 = \underline{\mathbf{0.201}}$	$=P(P=H\|C^T,S^T)*P(P\|S^T) /P(C\|S^T) = P(C\|S^T,P^T)*P(P=H) / (P(C\|P^T,S^T)*P(P) + P(C\|P^F,S^T)*(1-P(P))) = 0.05*0.1/(0.05*0.1 + 0.03 * 0.9) = \underline{\mathbf{0.156}}$
Bel(S=T)	$=P(S) = \underline{\mathbf{0.5}}$		$=\underline{\mathbf{1}}$		$=\underline{\mathbf{1}}$
Bel(C=T)	$=(P(C=T\|P^H,S^T) * P(P=H) * P(S=T))+ (P(C=T\|P^H,S^F) * P(P=H) * P(S=F))+ P(C=T\|P^L,S^T) * P(P=L) * P(S=T) + P(C=T\|P^L,S^F) * P(P=L) * P(S=F) = (0.05 * 0.1 * 0.5) + (0.02 * 0.1 * (1 - 0.5)) + (0.03 * 0.9 * 0.5) + (0.001 * 0.9 * (1 - 0.5)) = \underline{\mathbf{0.174}}$	$=P(C=T\|D^T) = P(D=T\|C^T) * P(C=T) / (P(D=T\|C^T) * P(C=T) + P(D=T\|C^F) * (1 - P(C=T))) = 0.65 * 0.011 / (0.65 * 0.011 + 0.5 * (1-0.011) =\underline{\mathbf{0.037}}$	$=P(C=T\|S^T) = P(C\|S^T,P^T)*P(P) + P(C\|S^T,P^T)*P(P^T) + P(C\|S^T,P^F) * P(P^F) = 0.05 * 0.1 + 0.03 * 0.9 = \underline{\mathbf{0.032}}$	$=\underline{\mathbf{1}}$	$=\underline{\mathbf{1}}$
Bel(X=pos)	$=P(X=pos\|C^T)*P(C=T) + P(X=pos\|C^F) * P(C=F) = 0.9 * 0.01163 + 0.2 * (1-0.01163) = \underline{\mathbf{0.212}}$	$=P(X=pos\|D=T)=P(X=pos\|D^T,C^T)*P(C=T\|D^T) + P(X=pos\|D^T,C^F) * P(C=F\|D^T) = P(X=pos\|C^T)*(P(C=T\|D^T) + P(X=pos\|C^F) * P(C=F\|D^T) = 0.9*0.025 + 0.2 * 0.974= 0.226$	$=P(X=pos\|C^T) = P(X=pos\|C^T)*P(C^T) + P(X=pos\|C^F)*P(C^F)=0.9*0.032 + 0.2 * 0.968 = \underline{\mathbf{0.311}}$	$=P(X=pos\|C^T) = P(X=pos\|C^T)*P(C=T) = 0.9*1 = \underline{\mathbf{0.9}}$	$=P(X=post\|C^T,S^T)=P(X=pos\|C^T)*P(C=T) = 0.9*1 = \underline{\mathbf{0.9}}$
Bel(D=T)	$=P(D=T\|C^T) * P(C=T)+ P(D=T\|C^F) * P(C=F)= 0.65 * 0.01163 + 0.5 * (1-0.01163) = \underline{\mathbf{0.306}}$	$=P(D=T\|D^T) = \underline{\mathbf{1}}$	$=P(D=T\|C^T) = P(D=T\|C^T)*P(C) \mid P(D=T\|C^F) = 0.65*0.032 + 0.5 * 0.968 = \underline{\mathbf{0.222}}$	$=P(D=T\|C^T) = P(D=T\|C^T)*P(C=T) = 0.65*1 = \underline{\mathbf{0.65}}$	$=P(D=T\|C^T,S^T)=P(D=T\|C^T) * P(C=T) = 0.65*1 = \underline{\mathbf{0.65}}$