Lab5 - Bayesian Networks

Maxime Lhoustau and Philipp Schlieker

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General Information

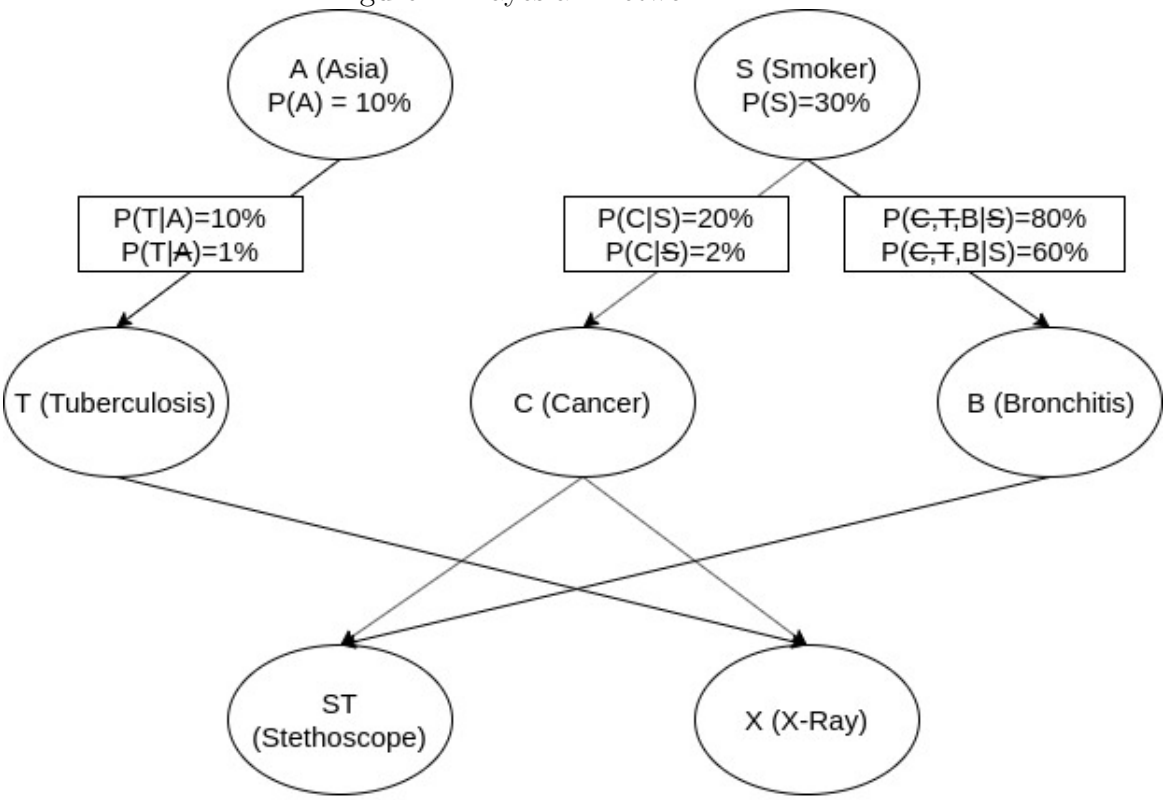
A = "Person has recently visited Asia"
S = "Person is a smoker"
T = "Person has tuberculosis"
L = "Person complains about lung problems"
C = "Person has cancer"
B = "Person has only a bronchitis"
ST = "Stethoscope test is positive"
X = "X-Ray is positive"
$P(A) = 10\%$
$P(S) = 30\%$
$P(T|A) = 10\%$
$P(T|\bar{A}) = 1\%$
$P(C|S) = 20\%$
$P(C|\bar{S}) = 2\%$
$P(\bar{C}, \bar{T}, B|\bar{S}) = 80\%$
$P(\bar{C}, \bar{T}, B|S) = 60\%$

		ST	
B	C	F	T
T	T		60%
T	F		60%
F	T		60%
F	F	99%	

		X	
T	C	F	T
T	T		70%
T	F		70%
F	T		70%
F	F	98%	

1 Model this problem using a Bayesian network

Figure 1: Bayesian Network



B	C	ST F	ST T
T	T		60%
T	F		60%
F	T		60%
F	F	99%	

T	C	X F	X T
T	T		70%
T	F		70%
F	T		70%
F	F	98%	

2 If the patient is not smoking and has not recently visited Asia, can you infer with disease?

No, it is not possible to infer the disease with 100% certainty. The disease with the highest probability is Bronchitis.
$P(\bar{A}, \bar{S}, T) = P(T|\bar{A}, \bar{S}) * P(\bar{A}|\bar{S}) * P(\bar{S}) = 0.01 * 0.9 * 0.7 = 6.3\%$
$P(\bar{A}, \bar{S}, C) = P(C|\bar{A}, \bar{S}) * P(\bar{A}|\bar{S}) * P(\bar{S}) = 0.02 * 0.9 * 0.7 = 12.6\%$
$P(\bar{A}, \bar{S}, B) \geq P(\bar{A}, \bar{S}, B, \bar{T}, \bar{C}) = P(B, \bar{T}, \bar{C}|\bar{A}, \bar{S}) * P(\bar{A}|\bar{S}) * P(\bar{S}) = 0.8 * 0.9 * 0.7 = 50.4\%$

3 According to the disease inferred in Point 2, the doctor decides to auscultate the patient's lungs with a stethoscope? Why?

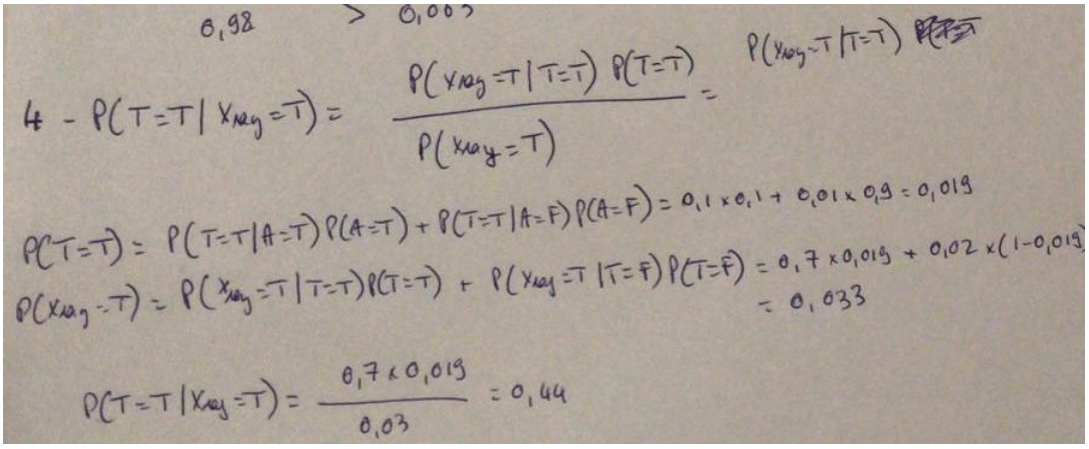
In order to decide whether the person has a Bronchitis this test is helpful. If the person has a bronchitis, than it is highly likely that he will not have cancer and tuberculosis.

The stethoscope test is negative. What is the new inferred diagnosis?

The disease with the highest likelihood is now tuberculosis.
$P(\bar{A}, \bar{S}, C, \bar{ST}) = P(\bar{A}, \bar{S}, C) * P(C|\bar{ST}) = 12.6\% * 1\% = 0.126\%$
$P(\bar{A}, \bar{S}, B, \bar{ST}) = P(\bar{A}, \bar{S}, B) * P(C|\bar{ST}) = 50.4\% * 1\% = 0.504\%$
$P(\bar{A}, \bar{S}, T, \bar{ST}) = P(\bar{A}, \bar{S}, T) = 6.3\%$

4 The doctor orders an X-Ray. The X-Ray test is positive. What is the new inferred diagnosis?

Tuberculosis



5 Was the X-Ray needed?

The X-Ray increased the certainty.