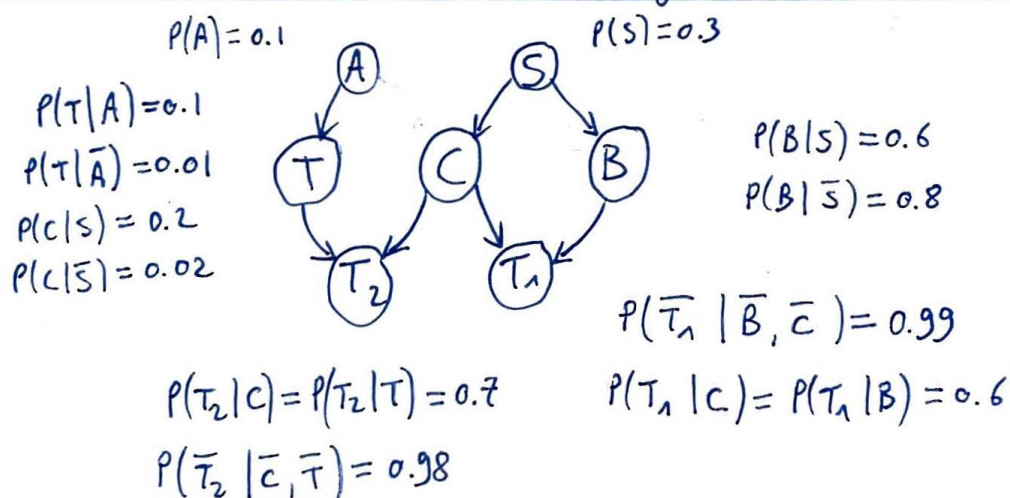


Medical Diagnosis

1. Patient has : A « visited Asia »  
 S « smoked »  
 T « tuberculosis »  
 C « cancer »  
 B « bronchitis »

$T_1$  : « stethoscope test positive »,  $T_2$  : « X-ray test positive »

We have:



2. Given  $P(T|\bar{A}, \bar{S}) = \frac{P(T, \bar{A}, \bar{S})}{P(\bar{A}, \bar{S})}$  (Bayes) and according to the network,

$$P(T, \bar{A}, \bar{S}) = P(T|\bar{A})P(\bar{A})P(\bar{S}), \text{ we have } P(T|\bar{A}, \bar{S}) = \frac{P(T|\bar{A})P(\bar{A})P(\bar{S})}{P(\bar{A}, \bar{S})} \text{ but } \bar{A} \text{ and } \bar{S}$$

are conditionally independant so  $P(\bar{A}, \bar{S}) = P(\bar{A})P(\bar{S})$  therefore  $P(T|\bar{A}, \bar{S}) = P(T|\bar{A}) = 0.01$ .

Similarly, we get  $P(C|\bar{A}, \bar{S}) = P(C|\bar{S}) = 0.02$  and  $P(B|\bar{A}, \bar{S}) = P(B|\bar{S}) = 0.8$  which is higher than the previous two, thus we infer bronchitis B.

3. The doctor uses  $T_1$  (stethoscope test) because it is the only one to provide information on bronchitis (and thus could allow him to infer a diagnosis).

X-ray does not give such information.

We inferred bronchitis in question 2 and we know  $P(T_1|B) = 0.6$  and  $P(\bar{T}_1|B) = 0.4$ .

The test is negative. The new inferred diagnosis is  $\bar{B}$  and  $\bar{C}$  because if the patient had either cancer or bronchitis, it was likely (60%) that the test would have been positive.

Another way of seeing it is to consider that given  $P(\bar{T}_1|B) = 0.4$ ,  $P(\bar{T}_1|C) = 1 - P(T_1|C) = 0.4$  we have

$$P(\bar{T}_1|\bar{B}, \bar{C}) = 0.99 > P(\bar{T}_1|B) \text{ and } > P(\bar{T}_1|C)$$

so it would be more likely to have  $\bar{B}$  and  $\bar{C}$  in the first place.

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4. We already excluded the fact that the patient could have cancer.

The X-ray test should be positive 70% of the time when patient has either cancer or tuberculosis.

The test was positive: we infer that the patient has tuberculosis ( $T$ ).

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5. Question 3 already put aside bronchitis and cancer, the remaining disease was therefore tuberculosis. X-rays allowed to confirm the doctor's suspicions but in absolute terms, X-rays were not needed.