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Fachrichtung 6.2 – Informatik
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11th Theoretical Assignment in Artificial Intelligence (WS 2006/2007)

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Exercise 11.1

In a galaxy far, far away, 90% of the taxicabs are green and 10% are blue. An accident involving a taxicab occurs; we presume that the accident rate for green taxicabs is the same as for blue taxicabs. A court considers the accident, and a newspaper reporter who was at the scene says, “The cab involved at the scene was blue”. This reporter is usually reliable; in fact, his statements are correct 80% of the time. That is, if the taxicab involved in the accident was in fact blue (or green), the probability that our witness would say “blue” (or “green”) is 0.8. What is the probability that the taxicab involved in the accident was blue, given the reporter’s statement? (from Nils J. Nilsson: Artificial Intelligence, 1998)

Exercise 11.2

> *Three prisoners A, B and C are locked up in their cells. Everybody knows that one of them will be put to death the next morning and the two others will be pardoned. The decision who will be put to death has already been made by the governor. The prisoner A asks the guard a favour: “Please ask the governor who will be put to death tomorrow and tell one of the other two prisoners that he will be pardoned.”*

Assume that the guard accepts and returns to tell A to whom of his fellow prisoners he passed the pardon message. To represent that situation, we use to variables $Execute$ and $GuardSays$. The possible values of $Executed$ are $\{A, B, C\}$, the possible values for $GuardSays$ are $\{B, C\}$. The joint probability distribution for the situation is

	$Execute = A$	$Execute = B$	$Execute = C$
$GuardSays = B$	$\frac{1}{6}$	0	$\frac{1}{3}$
$GuardSays = C$	$\frac{1}{6}$	$\frac{1}{3}$	0

(a) Why are there two values $\frac{1}{6}$ in each row of the column for $Execute = A$, while for the other two columns there is one row with $\frac{1}{3}$ and the other is 0? (Hint: Compute $P(GuardSays = B|Execute = A)$ and $P(GuardSays = C|Execute = A)$).

(b) What is the conditional probability of A being executed the next day given B is not executed the next day? (justify your answer mathematically!)

(c) The guard returns to tell A that he passed the pardon message to prisoner B. What is the conditional probability of A being executed the next day if the guard says B is not executed the next day? (justify your answer mathematically!)

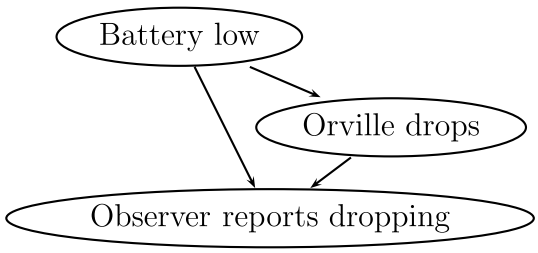
Exercise 11.3

From Nils J. Nilsson: Artificial Intelligence, 1998: Orville, the robot juggler, drops balls quite often when the battery is low. In previous tests, it has been determined that the probability that it will drop a ball when its battery is low is 0.9. Whereas when its battery is not low, the probability that it drops a ball is only 0.01. The battery was recharged not so long ago, and our best guess (before looking at Orville's latest juggling record) is that the odds that the battery is low are 10 to 1 against. A robot observer, with a somewhat unreliable vision system, reports that Orville dropped a ball. The reliability of the observer is given by the following probabilities:

$$p(\text{observer says that Orville drops}|\text{Orville does drop}) = 0.9$$

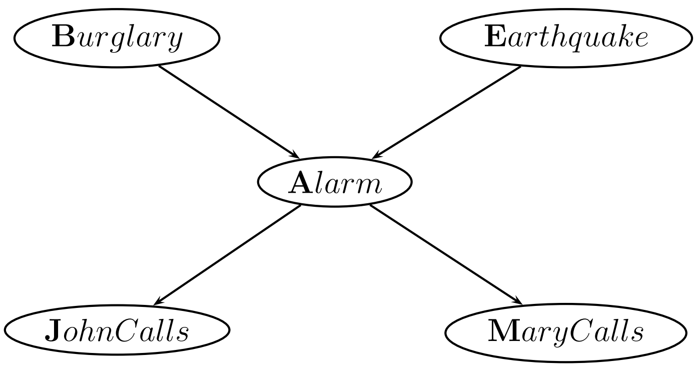
$$p(\text{observer says that Orville drops}|\text{Orville does not drop}) = 0.2$$

- Draw the Bayes network (and indicate the conditional probability tables)!
- Calculate that the battery is low given that the observer reports that Orville drops the ball.
- Consider the following network (with probabilities omitted). Is it a correct Bayes network for the problem? Do you think that any other aspect of this network might be unsatisfactory?



Exercise 11.4

In this exercise we consider the example introduced in the lecture. There, the following Bayes net was presented:



The *a priory* probabilities and conditional probabilites are:

P(B)
.001

P(E)
.002

B	**E**	**P(A)**
T	*T*	.95
T	*F*	.94
F	*T*	.29
F	*F*	.001

A	**P(J)**
T	.90
F	.05

A	**P(M)**
T	.70
F	.01

Compute the following conditional probabilities with the technique for exact inference presented in the lecture (also see Russell/Norvig, p. 504 ff.). Indicate all computations!

1. $\mathbf{P}(\mathbf{J} \mid \mathbf{B}) = ?$
2. $\mathbf{P}(\mathbf{B} \mid \mathbf{A}) = ?$
3. Explain the state of affairs that are considered in 1. and 2. in (ordinary) English or German sentences!