



DEPARTAMENTO DE INFORMÁTICA
UNIVERSIDAD CARLOS III DE MADRID

Grado en Ingeniería en Informática

Artificial Intelligence Partial exam 2

April 2016

General indications

- Time assigned to the exam is **2 hours**
- You cannot leave the classroom during the exam, unless you have finished it
- Exams cannot be answered using a pencil

Exercise 1 (2.5 p)

As of 2009, Swaziland had the highest HIV prevalence in the world. 25.9% of this country's population is infected with HIV. The ELISA test is one of the first and most accurate tests for HIV. For those who carry HIV, the ELISA test is 99.7% accurate. For those who do not carry HIV, the test is 92.6% accurate. If an individual from Swaziland has tested positive, what is the probability that s/he carries HIV?

Exercise 2 (2.5 p)

Consider the following Bayesian Network

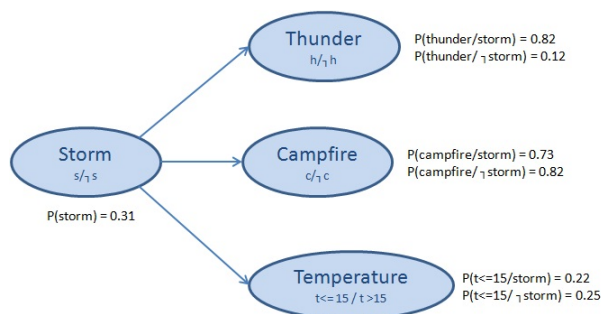


Fig. 1: Bayesian Network exercise 2.

- Given evidence that temperature is higher than 15 degrees, compute the probability of storm (i.e. $P(\text{storm}/t > 15)$). *Note: For this question **compute** the exact probability.* (1.25 p)
- Given evidence that temperature is higher than 15 degrees and that there is a campfire, compute the probability of storm (i.e. $P(\text{storm}/t > 15, \text{campfire})$). *Note: For this question you can leave the result as $\alpha * \text{your} - \text{result}$.* (1.25 p)

Exercise 3 (2.5 p)

It is said that students can either study, sleep or talk with friends.

When they are in class and study, they usually pass the course with a probability of 0.7, repeat the course (that is, remain in class) with a probability of 0.1, and decide to go to the pub with a probability of 0.2. However, when they are in class and talking, they only pass with probability 0.3, they'll remain in class with probability 0.3 and they'll decide to go to the pub with a probability of 0.4. Students sometimes sleep in class which results in staying in class with a probability of 0.8 and passing with a probability 0.2.

Students in the pub can either study or talk. When they study they normally pass with probability 0.3, decide to go to class with probability 0.5 and stay studying in the pub with probability 0.2. When they are talking the probability of passing is of 0.3 otherwise they'll continue in the pub.

The cost of studying is of 6, of talking is 10 and the cost of sleeping is 20.

Note that obviously our goal is to pass.

- Model formally the MDP. (0.5 p)
- Specify the Bellman's equations that update the values of states. (1 p)
- Compute the expected value $V(s)$ for each of the states. Do 3 iterations, $t=0, t=1, t=2$. (1 p)

Exercise 4 (2.5 p)

An expert in control of turbines has provided us the following rules which are codified in a control system:

- If the noise level is normal and the temperature is high, then set the velocity to low.
- If the noise level is normal and the temperature is not high, then set the velocity to medium.
- If the noise level is low, then set the velocity to high.

The variables are fuzzified as shown in the figure. Calculate the output of the control system for a temperature of 20 degrees and a noise level of 5db.

Note: use as defuzzification method the Centroid of Area (COA).

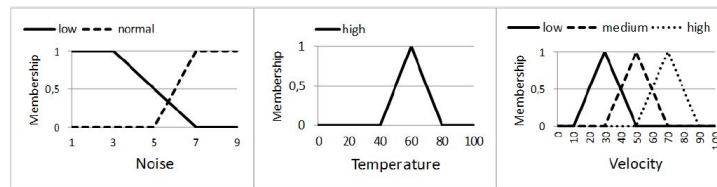


Fig. 2: Membership functions exercise 4.