

## Final Exam

### CS557E: Artificial Intelligence

#### Washington University of Virginia

##### **Exercise 1**

In your local nuclear power station, there is an alarm that senses when a temperature gauge exceeds a given threshold. The gauge measures the temperature of the core. Consider the Boolean variables A (alarm sounds), FA (alarm is faulty), and FG (gauge is faulty) and the multivalued nodes G (gauge reading) and T (actual core temperature).

- Draw a Bayesian network for this domain, given that the gauge is more likely to fail when the core temperature gets too high.
- Is your network a polytree? Why or why not?
- Suppose there are just two possible actual and measured temperatures, normal and high; the probability that the gauge gives the correct temperature is  $x$  when it is working, but  $y$  when it is faulty. Give the conditional probability table associated with G.
- Suppose the alarm works correctly unless it is faulty, in which case it never sounds. Give the conditional probability table associated with A.
- Suppose the alarm and gauge are working and the alarm sounds. Calculate an expression for the probability that the temperature of the core is too high, in terms of the various conditional probabilities in the network.

##### **Exercise 2**

Consider the problem faced by an infant learning to speak and understand a language. Explain how this process fits into the general learning model. Describe the percepts and actions of the infant, and the types of learning the infant must do. Describe the subfunctions the infant is trying to learn in terms of inputs and outputs, and available example data.

##### **Exercise 3**

Complete the missing step in the derivation of Equation (15.19) on page 586 of the textbook, the first update step for the one-dimensional Kalman filter.

##### **Exercise 4**

Consider an arbitrary Bayesian network, a complete data set for that network, and the likelihood for the data set according to the network. Give a simple proof that the likelihood of the data cannot decrease if we add a new link to the network and recompute the maximumlikelihood parameter values.