CSC242: Homework 3.1
AIMA Chapter 13.0–13.3

1. Summarize *briefly* why using logic exclusively to formalize a domain like medical diagnosis is hard.

2. True or false: A prior (or unconditional) probability takes into account all relevant other information.

3. Posterior (conditional) probabilities are conditional on what?

4. Prove that $P(a \mid b \wedge a) = 1$. Use the definition of conditional probability and some basic properties of conjunction.

5. Suppose we have the following situation involving an auto repair shop:

   - Cars can be one of three types: economy (inexpensive), midrange, and luxury (expensive).
   - The only symptoms that the shop technicians can detect are whether the car is rattling and whether it is squeaky.
   - The only problems that the repair shop can diagnose (and hopefully fix) involve either the brakes, clutch, electrical system, steering, or tires.
   - Furthermore, they assume that there is only one problem with any car at one time.

   I admit that this is probably not the best auto repair shop.

   (a) Give a formalization of this domain using random variables and their domains.

   (b) Give a formula expressing the knowledge that squeaky luxury cars have brake problems 75% of the time, using your formalization and the notational conventions used in the book and in class.

   (c) Give a formula expressing the knowledge that non-squeaky non-luxury cars have brake problems 20% of the time.

   (d) Your formalization may be different from mine, but try to give an English translation of the following conditional probability statement:

$$P(\mathit{clutch} \mid \mathit{rattling} \wedge \neg \mathit{squeaky} \wedge \mathit{luxury}) = 0.4$$

6. Assume a random variable $Cuisine$ with values

$$\{american, japanese, chinese, french, polish\}$$

representing the type of meal served in a cafeteria for lunch. What does the following probability statement say?

$$\mathbf{P}(Cuisine) = \langle 0.5, 0.2, 0.2, 0.1, 0 \rangle$$

7. Suppose that you used the following random variables for the auto repair shop example from before:

   - $Type : \{economy, midrange, luxury\}$
   - $Rattling : \{true, false\}$
   - $Squeaky : \{true, false\}$
   - $Problem : \{brakes, clutch, electrical, steering, tires\}$

   Using these random variables, draw (or describe) tables showing the elements of the following joint probability distributions (of course you can't fill in the values):

   (a) $\mathbf{P}(Problem, Type)$

   (b) $\mathbf{P}(Problem, Type, Rattling)$

   (c) $\mathbf{P}(Problem, Type, Rattling, Sqeaky)$