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CISC 481 Homework 3

Due: May 17, 2022

**Problem 1**

Diagram

Description automatically generatedCalculate the probability that it’s a summer night, given an accident has been reported on the freeway.

In other words, .

Show your work.

|  |  |
| --- | --- |
| **Node** | **Variable\*** |
| Summer |  |
| Night |  |
| Rain |  |
| Wet Road |  |
| Poor Visibility |  |
| Accident |  |

\*Abbreviations used later

**Figure 1.** Bayesian Network detailing highway risk.

I will be referencing Bayesian Inference slides of the probabilistic-reasoning.pdf that was provided to us on Canvas.

I met with Professor Keffer on May 12th, at 3:00 PM to understand how to solve this problem.

A picture containing text, blackboard, person

Description automatically generated

**Figure 2.** Office hour work with Professor Keffer (pictured).

We first need to build the start of this equation. We’ll call this **equation 1**.

At the end of the equation, we separate out , which becomes our (alpha). We will tackle this part of the equation, later. For now, we have , which we will need to build.

**Important:** In Bayesian inference, every argument of the probability function needs to build out for all the nodes given its parents. These are built in summations for every combination of true and false for all the unmentioned variables in the graph. Since we’re looking for only the probability of , then we need to look at the combinations of . In respective order, we need to look at the true and false probabilities of rain, wet road, and poor visibility.

We need to essentially build this term. Let’s call this **term 1**.

For every combination of true and false of , which is possibilities. The table of these possibilities looks like the following

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| 1 | **T** | **T** | **T** |
| 2 | **T** | **T** | **F** |
| 3 | **T** | **F** | **T** |
| 4 | **F** | **T** | **T** |
| 5 | **F** | **T** | **F** |
| 6 | **T** | **F** | **F** |
| 7 | **F** | **F** | **T** |
| 8 | **F** | **F** | **F** |

To enumerate through all these possibilities, we will now define the following

, ,

And we will build **term 1** with all the possibilities. Let’s call this **equation 2**.

We will now enumerate all the possibilities on the next page.

We will now expand **equation 2** into what we will call **equation 3** below.

Now in the same way that we enumerate all the possibilities of for true and false, we will now also need to repeat equation for all the possibilities of , as we are looking at the probability of an accident given that it is summer and a night. And summer and night have their own probabilities which we must consider. The different true/false combinations of just is , which will look like

|  |  |  |
| --- | --- | --- |
|  |  |  |
| 1 | **T** | **T** |
| 2 | **T** | **F** |
| 3 | **F** | **T** |
| 4 | **F** | **F** |

We will enumerate this equation on the next page.

We will now expand **equation 3** into what we will call **equation 4**.

Great. The performance of Microsoft Word with this equation in my document has been seriously degraded, but at least it is formatted nicely.

We will now need to solve this equation with the proper values. We will fill in **equation 4** on the next page.

Here we will replace **equation 4** with the proper values. We will call this **equation 5**.

Appendix

This is **term 1**, again.

It is written like this because the probability of summer () and night () are given and have no parents like the other nodes do. So, they are just the probabilities of summer and night with no given (). Accident () has the parent probabilities’ of wet road () and poor visibility (), so that is why it is written as the probability of an accident given a wet road and poor visibility ().