

Washington State University
School of Electrical Engineering and Computer Science
Fall 2021

CptS 440/540 Artificial Intelligence

Homework 7

Due: October 21, 2021 (11:59pm pacific time)

General Instructions: Put your answers to the following problems into a PDF document and upload the document as your submission for Homework 7 for the course CptS 440 Pullman (all sections of CptS 440 and 540 are merged under the CptS 440 Pullman section) on the Canvas system by the above deadline. Note that you may submit multiple times, but we will only grade the most recent entry submitted before the deadline.

1. Consider the following full joint probability distribution to help us determine when the Cougars will win. Compute the following probabilities. Show your work.

| Win | | true | | false | |
|---------|--------|---------|------|---------|------|
| Uniform | | crimson | gray | crimson | gray |
| Weather | clear | 0.18 | 0.08 | 0.06 | 0.08 |
| | cloudy | 0.08 | 0.10 | 0.07 | 0.09 |
| | rainy | 0.05 | 0.09 | 0.08 | 0.04 |

- a. $P(\text{Win}=\text{true}, \text{Uniform}=\text{crimson}, \text{Weather}=\text{clear})?$
 - b. $P(\text{Weather}=\text{clear})?$
 - c. $P(\text{Uniform}=\text{crimson})?$
 - d. $P(\text{Win}=\text{true} \mid \text{Weather}=\text{clear})?$
 - e. $P(\text{Win}=\text{true} \mid \text{Weather}=\text{cloudy} \vee \text{Weather}=\text{rainy})?$
2. Consider the problem with three Boolean random variables: Win, Practice, Healthy. Assume you know only the following information:
- $P(\text{Win}=\text{true}) = 0.7$
 - $P(\text{Practice}=\text{true} \wedge \text{Healthy}=\text{true} \mid \text{Win}=\text{true}) = 0.8$
 - $P(\text{Practice}=\text{true} \wedge \text{Healthy}=\text{true} \mid \text{Win}=\text{false}) = 0.4$

Using Bayes rule and normalization, compute $\mathbf{P}(\text{Win} \mid \text{Practice}=\text{true} \wedge \text{Healthy}=\text{true})$. Note the “**P**” is boldfaced, so we want a distribution.

3. Suppose we have the 3x3 Wumpus world shown below. Your agent visited locations (1,1), (2,1), and (1,2), and perceived breezes in (2,1) and (1,2). The agent then takes a calculated risk, moves to (3,1), but unfortunately encounters a pit. Given this information, we want to compute the probability of a pit in (2,2). You may use $p_{x,y}$ and $\neg p_{x,y}$ as shorthand notation for $\text{Pit}_{x,y}=\text{true}$

and $\text{Pit}_{x,y}=\text{false}$, respectively. Similarly, you may use $b_{x,y}$ and $\neg b_{x,y}$ as shorthand notation for $\text{Breeze}_{x,y}=\text{true}$ and $\text{Breeze}_{x,y}=\text{false}$, respectively. Specifically,

- a. Define the sets: *breeze*, *known*, *frontier* and *other*.
- b. Following the method in the textbook and lecture, compute the probability distribution $\mathbf{P}(\text{Pit}_{2,2} \mid \text{breeze}, \text{known})$. Show your work.

| | | |
|--------------|-------|---|
| | | |
| B, OK | | |
| \neg B, OK | B, OK | P |

4. *CptS 540 Students Only*. Suppose an oracle tells the agent in Question 3 that there is a breeze in (3,3). Will this change the probability of a pit in (2,2)? Justify your answer.