

---

# CMSI 485 – Classwork 3

---

**Instructions:**

This worksheet will not only provide you with practice problems for your upcoming exam, but will add to your deep understanding of the mechanics of many probabilistic reasoning systems.

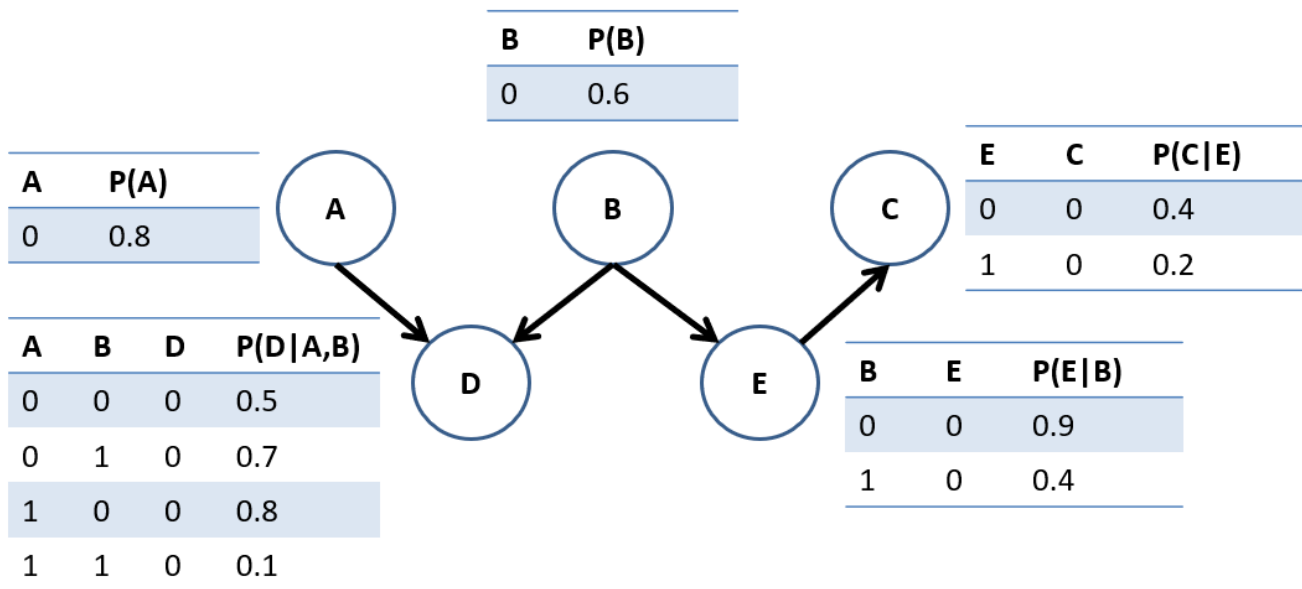
- Provide answers to each of the following questions and write your responses in the blanks. If you are expected to show your work in arriving at a particular solution, space will be provided for you.
- Place the names of your group members below:

**Group Members:**

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_

## Problem 1 – Bayesian Network Exact Inference

Consider the following Bayesian Network and use it to answer the questions that follow.



While examining Exact Inference in Bayesian Networks, we saw some methods for *simplifying* queries and the resulting computations that can yield large performance improvements when implemented. E.g., variables whose CPTs never affect the query outcome can be ignored.

**1.1.** For each of the following queries, determine *which variables' CPTs will at all affect* the answer to the query. Justify your responses in the boxes that follow. Hint: in your justification, express the query in terms of:  $P(Q|e) = \alpha \sum P(\dots)$  with  $\alpha = \frac{1}{P(e)}$

1.1.1.  $P(A|B = b, D = d)$

CPTs Used: \_\_\_\_\_ A \_\_\_\_\_ B \_\_\_\_\_ C \_\_\_\_\_ D \_\_\_\_\_ E

Justification:

1.1.2.  $P(E|D = d)$

CPTs Used: \_\_\_\_\_ A \_\_\_\_\_ B \_\_\_\_\_ C \_\_\_\_\_ D \_\_\_\_\_ E

Justification:

**1.2.** Using the Bayesian Network on the previous page, find the solutions to the following.

1.2.1.  $P(A = 0|B = 1, D = 1)$

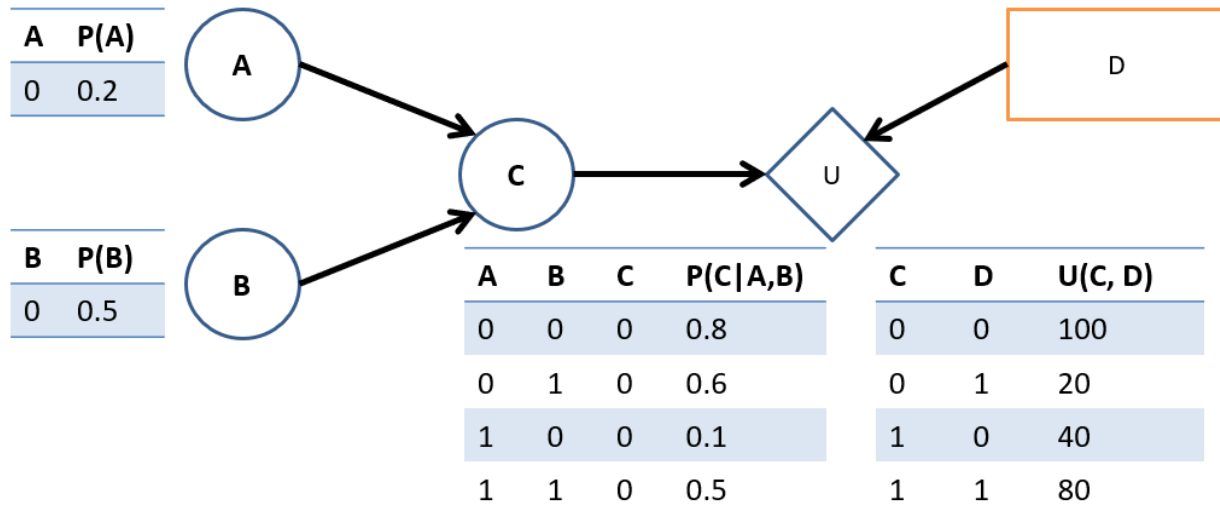
*(Box your answer once finished)*

1.2.2.  $P(B = 1|A = 0, D = 1, E = 0, C = 1)$

*(Box your answer once finished)*

## Problem 2 – Decision Networks & MEU

Use the following Decision Network with chance nodes  $A, B, C$ , decision node  $D \in \{0,1\}$ , and utility node  $U$  to answer the questions that follow.



2.1. Find the  $MEU(B = 0)$  (i.e., the Maximum Expected Utility with evidence  $B = 0$ ).

2.2. Given your computations above, what decision should your agent make by  $MEU$ ?

### Problem 3 – Value of Perfect Information

---

Using the network and your answer from the previous problem, we're going to compute the Value of Perfect Information (VPI) of knowing the state of variable  $A$  when  $B = 0$  is given. Let's do so step-by-step:

3.1. Find  $MEU(A = 0, B = 0)$ .

3.2. Using the your answer to 4.1 and knowledge that  $MEU(A = 1, B = 0) = 74$  (freebee!) find  $MEU(A, B = 0)$ .

3.3. Compute the  $VPI(A|B = 0)$ .

3.4. If the utility scores represent dollar amounts, what would be a fair price for  $A$  when  $B = 0$ ?

---