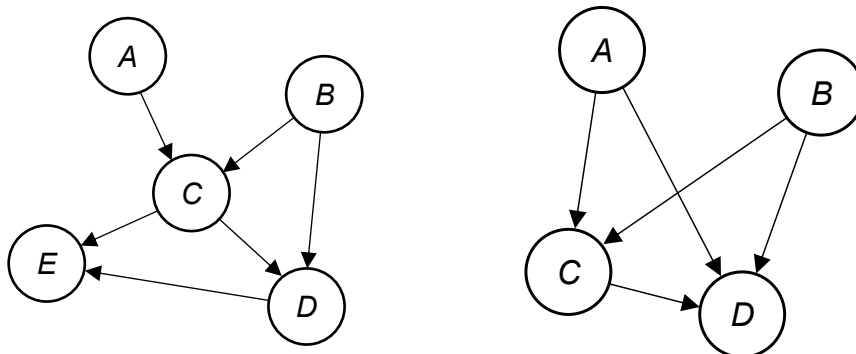# Worksheet 10: PGMs I

COMP90051 Statistical Machine Learning

Semester 1, 2021

Exercise 1. For the following PGMs:

(a) Find the factorized joint distribution.

(b) Count the number of free parameters in the conditional probability tables, assuming each variable is boolean.

(c) Find the conditional distribution $P(A|B)$, simplifying as much as possible.

Exercise 2. Regarding the rightmost PGM above:

1. Illustrate the form of the conditional probability table for $P(A)$ and $P(D|A, B, C)$. What data structure might be a good choice to implement each of these tables?

2. Considering the pairs of random variables $(A, B); (A, D); (C, D))$, state whether they are *marginally independent* or not. Note that X and Y are marginally independent if $P(X, Y) = P(X)P(Y)$, or equivalently $P(X|Y) = P(X)$.

Exercise 3 (Based on RN 14.15). Leo is a botanist who lives in the Bay Area. His neighbourhood is a hotspot for burglars, so his house is fitted with an alarm system. Unfortunately, the alarm is not perfectly reliable: it doesnt always trigger during a home invasion, and it may be erroneously triggered during minor earthquakes, which occur occasionally. Leo has asked his neighbours John and Mary (who don't know each other) to call him if they hear the alarm.

Construct a PGM to help model this scenario, with a view to allowing Leo to perform queries such as determining how likely his home has been invaded given he has heard from one or another of his neighbours. You will have to choose what random variables to use, what edges to add, and the direction of the edges to form the most natural model.