BKI PGMs – Case Studies

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Fall 2025

Abstract

1 Interview a Wildlife Biologist

1.1 Student-Facing

1.1.1 Problem Situation

You are *the PGM expert* on a small team working with a **wildlife conservation biologist** (*the domain expert*) who studies the behaviour of a threatened mountain fox population. The biologist believes certain environmental and ecological factors determine whether foxes are likely to be present in a given region during a survey. They want a probabilistic model that captures the relationships among the relevant factors so they can reason under uncertainty, run predictions, and plan conservation interventions.

Your job is to *interview the domain expert* (played by a TA) and construct a *directed graphical model* (Bayesian network) that represents the factors the biologist believes are involved. The domain expert *does not know PGM terminology* but knows their domain very well.

You should extract:

1. The relevant random variables and their possible values;
2. The directed relationship between these rvs, respecting the (in)dependencies that the domain expert implicitly believes to hold.
3. You should represent these independencies compactly in the form of a BN structure.

Your final output is a proposed graphical structure with variable definitions and rationales for their directed dependencies. We recommend a format like Table 1, Figure 1 and Table 2 in Appendix A illustrate.

1.1.2 Domain-Expert Pitch (TA's Opening Statement to Students)

I study the movement and behaviour of mountain foxes. Whether we find foxes in a region depends on a mix of ecological conditions. In general, foxes go where they can find food, avoid people, and where the weather allows them to be active. Also, the state of the environment, such as quality of vegetation and availability of prey, changes with the seasons and the weather. These factors affect how foxes behave and whether we are likely to see signs of them during our surveys. I want a model that helps me reason about all this when planning a survey or interpreting uncertain data.

A BN Example

RV	Description	Outcome Space
V	Viscosity captures a key property of the liquid through which the device is moving	lower-than-water, water-like, higher-than-water
P	Power is a property inherent to the device which may have one or another type of engine	low, high
S	Speed can be measured as the device moves through the liquid	slow, fast
...	...	...

Table 1: Identified random variables (TODO: list the rvs and choose a reasonable outcome space for them)

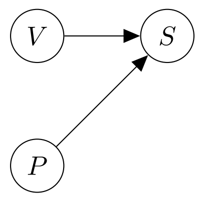

Figure 1: Proposed BN (TODO: state your choice of BN for this problem).

Node	Parents	Rationale
V	$\emptyset$	Viscosity is a fundamental property of the liquid, and we assume that the device moving through it is incapable of affecting it. Presumably, if the device generated a critical amount of heat, the viscosity of the liquid might change, but this condition is left out on the assumption that device's temperature is never near this critical level.
P	$\emptyset$	Power is treated as a fundamental property of the device's engine. We assume that movement does not affect the device's power (for example, because its battery is fully charged and the session is not too long). Last, we assume that the device is adequately insulated for this kind of liquid and, hence, the viscosity of the liquid does not affect the engine and its power yield.
S	V	In ideal conditions (viscosity near that of water), the speed of the particle is predicted by the device's power, but in general liquids we need to account for the effect of the liquid's viscosity, since thicker liquids offer stronger resistance.

Table 2: Rationales (TODO: for each node, give a rationale for choosing the parents you chose and why other intuitively reasonable parents were left out).