Advanced Artificial Intelligence

Exercise for Bayesian Networks

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Exercise

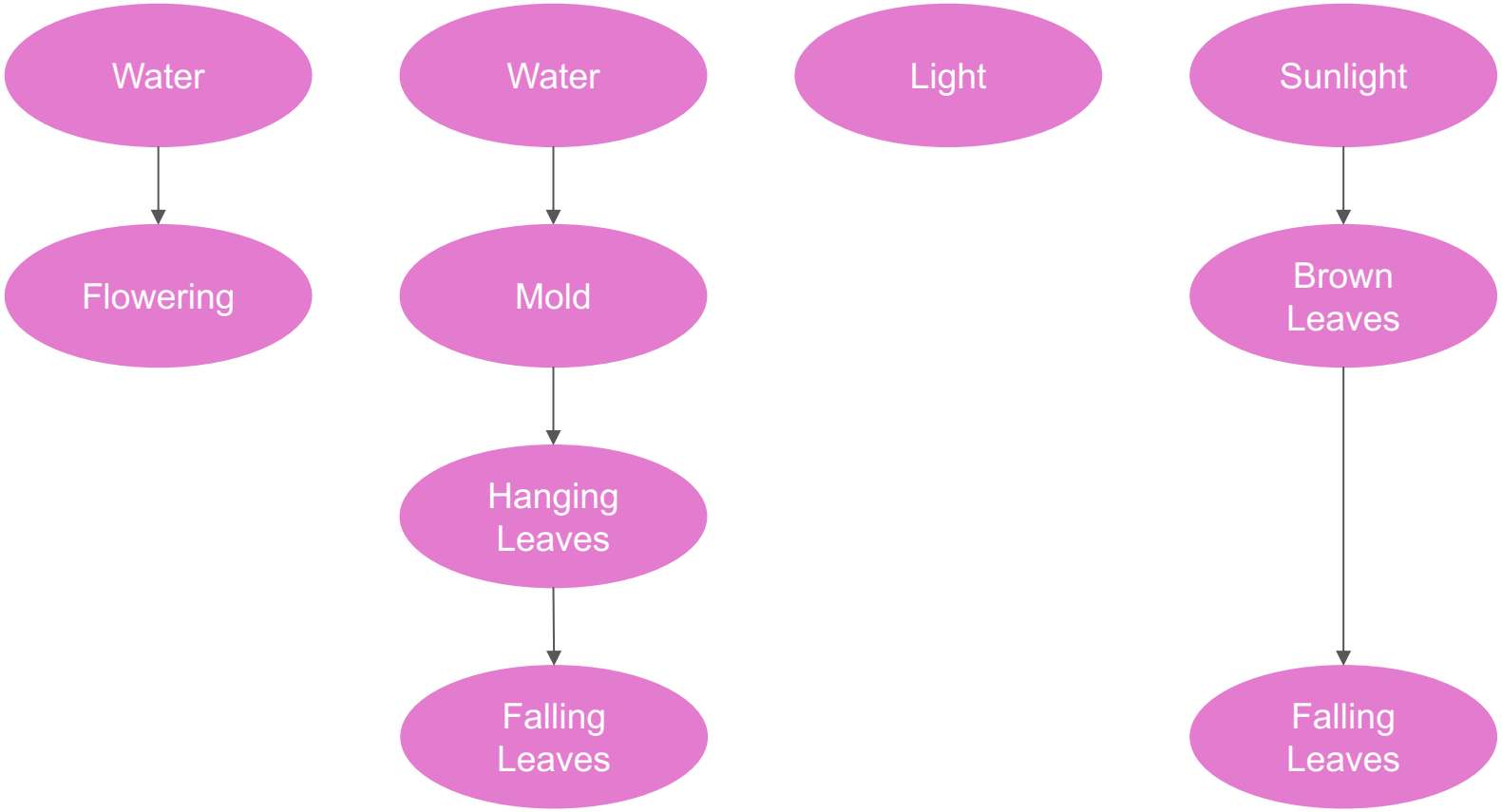
Flower Care Instructions

- The plant needs more water than usual plants.
- When watered appropriately it has a good chance of flowering.
- Too much water causes the roots to mold, which will lead to hanging leaves that might fall off.
- The plant needs a good amount of light, but not too much direct sunlight.
- In case of too much sun light the leaves will turn brown.
- Brown leaves will fall off eventually.

- Build a Bayesian network that models the plant in relation to the conditions mentioned in the instructions. Find probability values that matches with the natural language descriptions used in the care instructions (such as too much, appropriately) and ensure that your network shows clearly how different conditions for the plant (such as amount of water, amount of sunlight, amount of light) influence its wellbeing.
- In your network try to find the optimal amount of water, light and sunlight for the plant.
- Explain which of the nodes are dependent and why and which of the nodes are independent and why.

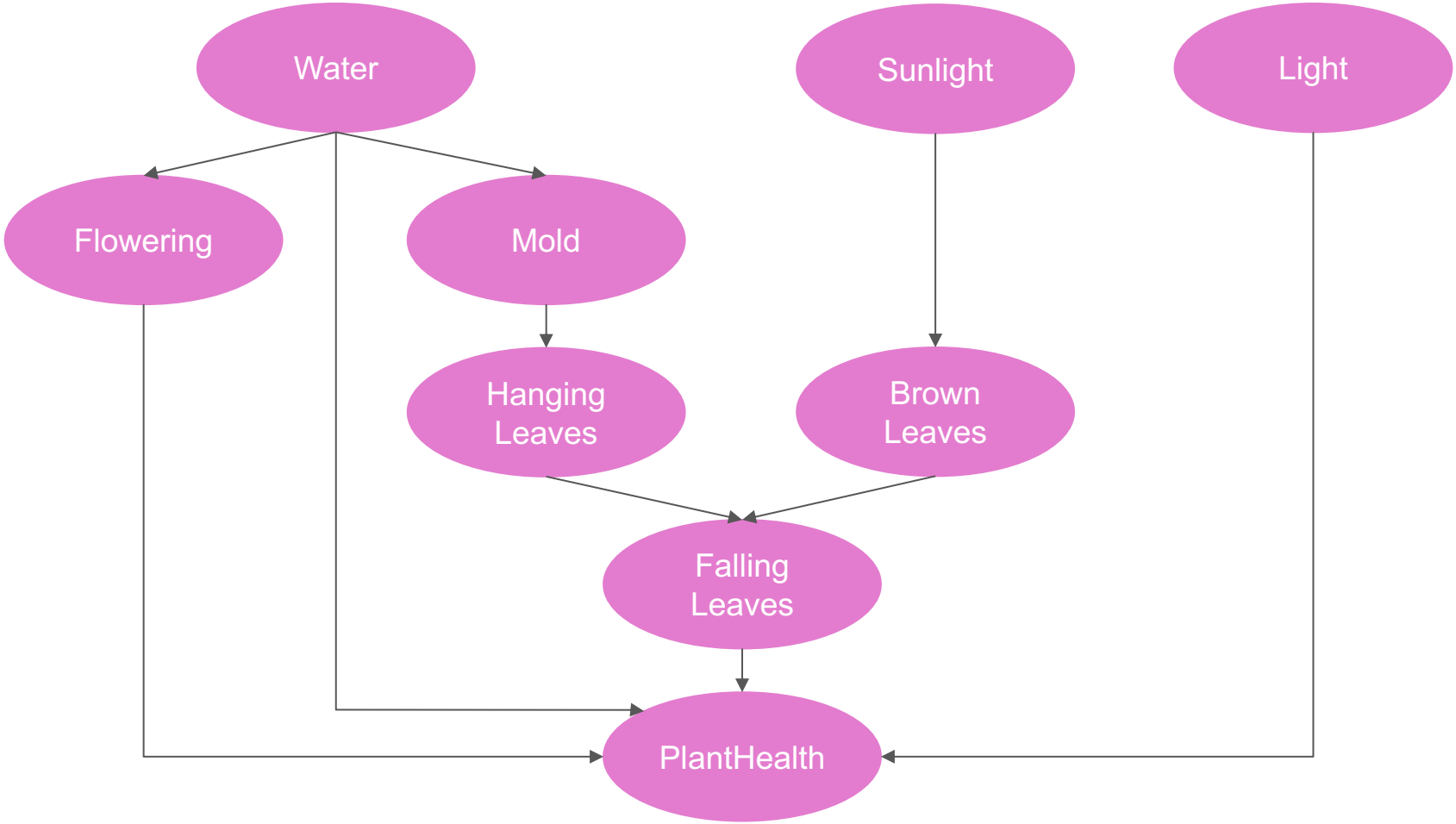
Bayesian Network (1)

Transforming the natural language descriptions into logical dependencies



Bayesian Network (2)

Abstracting the logical dependencies to define overall dependencies



Bayesian Network (3)

Defining the domains for all random variables

Water = { appropriate, ¬ appropriate }

Sunlight = { acceptable amount direct sunlight, too much direct sunlight }

Light = { good amount, insufficient amount }

Flowering = { true, false }

Mold = { true, false }

BrownLeaves = { true, false }

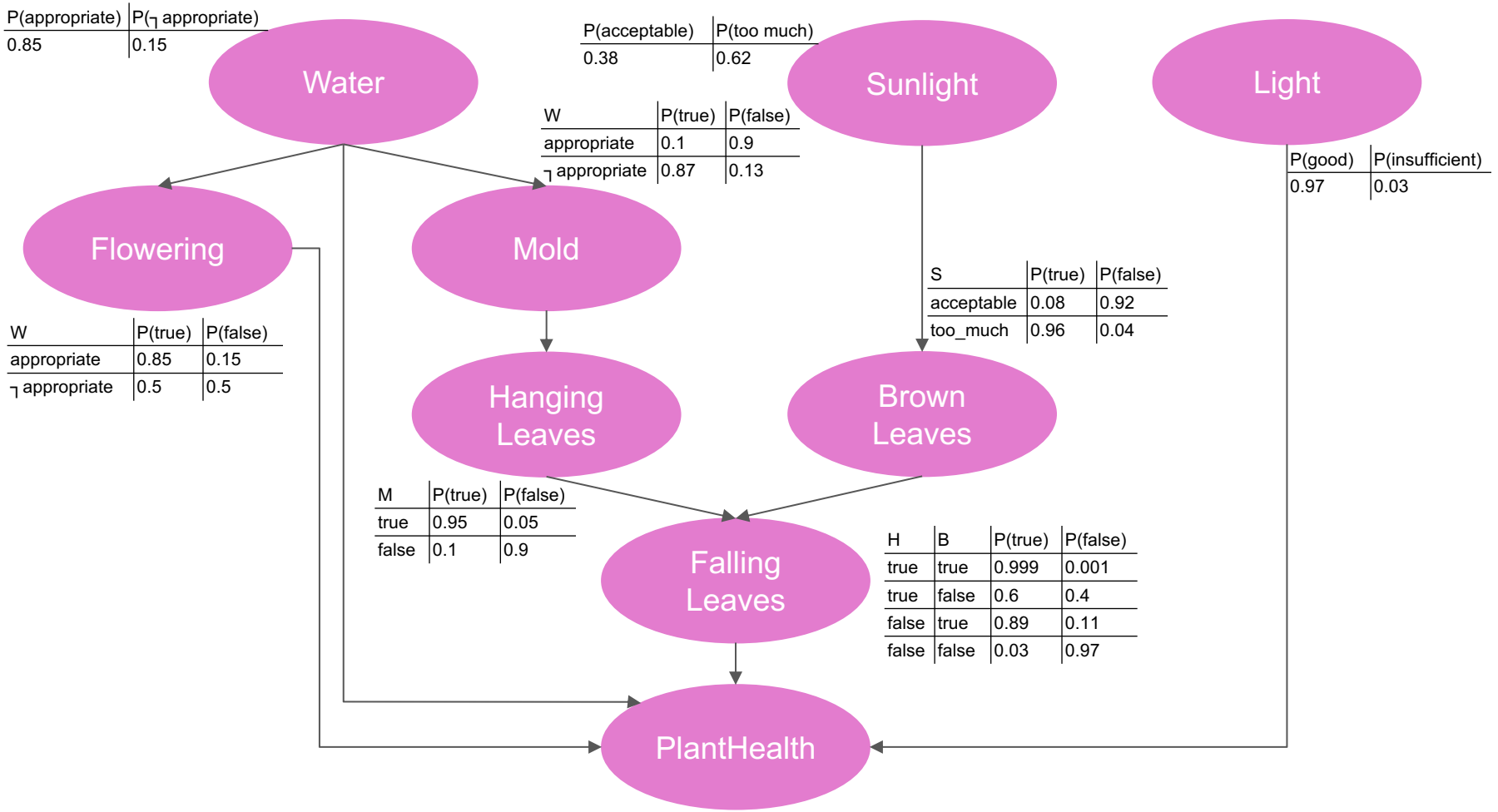
HangingLeaves = { true, false }

FallingLeaves = { true, false }

PlantHealth = { healthy, unhealthy }

Bayesian Network (4)

Assigning probability values to each node based on the natural language descriptions



Bayesian Network (5)

Applying Bayes' Rule

Causal direction:

"Probability of hanging leaves given that their is mold"

$$P(effect \mid cause) = \frac{P(cause \mid effect)\, P(effect)}{P(cause)}$$

$$P(hanging \mid mold) = 0.95$$

This information is often existent in the real world, as it is defined in this model in the conditional probability table for HangingLeaves (mold = true ∧ hanging = true).

Diagnostic direction:

"Probability of hanging leaves actually being caused by mold"

$$P(cause \mid effect) = \frac{P(effect \mid cause)\, P(cause)}{P(effect)}$$

$$P(mold \mid hanging) = \frac{P(hanging \mid mold)\, P(mold)}{P(hanging)}$$

$$= \frac{0.95 * 0.22}{0.28}$$

$$= 0.75$$

Bayesian Network (6)

Dependence & Independence

Independence is indicated by the absense of a direct link between nodes, so for example…

- Flowering is independent from Mold given Water, meaning that Water influences both Flowering and Mold, but there is no dependence on each other. A plant could very well have flowers and mold at the same time.
- Water is independent from Light and both of them are independet from Sunlight. While they all have an influence on the same random variable, PlantHealth, they will not influence each other. How watering is done, will not influence the amount of sunlight or general light absorption.

Dependence is indicated by a direct or indirect link between nodes, so for example…

- PlantHealth is directly influenced by the outcomes of Flowering, Water, Light and FallingLeaves. The determination of a plant's health will be dependent on the facts from these influencing variables.
- At the same time, PlantHealth is also indirectly influenced by HangingLeaves and BrownLeaves, because these variables have an influence on FallingLeaves.

Bayesian Network

Creating the Model using GeNie software