

Assignment 6

Subject

Topics of this session :

1. Independence, Conditional Independence.
2. Probabilistic graphical models / Belief networks.
3. Decision making under uncertainty.
4. One-shot decisions.
5. Stochastic gradient optimisation.

This assignment is graded and must be submitted (individually) on Moodle before next week's class.

For each exercise, detail your reflexion steps :

- We are mostly interested in your actual thinking process.
- Even if you are unable to solve an exercise, write out what were you reflexion steps.
- For each attempted exercise, a written feedback will be provided (if time allows it).

For coding :

- **Noto** (Online Jupyter NoteBook).
- Any other python coding environment you prefer using.

Exercise 1

Let's consider the N -meteorologist problem from last week.

Draw the corresponding graphical model of the problem, where nodes are the events, and directed edges represent relationships between events.

Exercise 2

A cab was involved in a hit-and-run accident at night. Two cab companies, Green and Blue, operate in the city. You are given the following data :

- 85% of the cabs in the city are Green and 15% are Blue.
- A witness identified the cab as Blue. The court tested the reliability of the witness in the circumstances that existed on the night of the accident and concluded that the witness correctly identifies each one of the two colors 80% of the time and fails 20% of the time.

Tasks :

1. Represent this story as a belief network (graphical model of the problem). Explain all variables and conditional probabilities. What is observed ? What is the probability that the cab involved in the accident was Blue ?

2. Suppose there were three independent witnesses, two of whom claimed the cab was Blue and one of whom claimed the cab was Green. Show the corresponding belief network. What is the probability that the cab was Blue ?
3. Suppose it was found that the two witnesses who claimed the cab was Blue were not independent, but there was a 60% chance they colluded. (What might this mean ?) Show the corresponding belief network, and the relevant probabilities. What is the probability that the cab was Blue ?

Project – Part 4

This whole section must be done in groups of 2-3 people.

This week, we will work on graphical models of our project problems.

1 Guided Project

Dungeon Gridworld We will consider the following formulation for our problem :

- The goal is to reach the stairs.
- Falling into a hole causes the game to end immediately.
- The agent **has partial visibility**, and only senses adjacent tiles :
 - Whenever the agent is adjacent to a hole, it hears an *Echo*.
 - Whenever the agent hits a wall, it senses a *Bump*.
 - Whenever the agent is in the same row or column as the stairs, it observes *Light*.
- additionally, we have the following **rules** :
 - Holes are *always* on the same row or column as the stairs.
 - The stairs are *never* adjacent to a hole.
 - If a tile is a wall, there *cannot* be any agent, hole or stairs there.

Task :

1. Assume our agent picks actions in $[\rightarrow, \leftarrow, \uparrow, \downarrow]$ randomly. then its coordinates at time t (x_t, y_t) can be seen as random variables. Draw a graphical model representing the relationships between the agent coordinates at time step t , with the events that the agent perceives an *Echo*, a *Bump*, *Light*, and that there walls in the adjacent tiles.

2 Personal Project

For your project, follow these steps :

1. Draw a graphical model for your problem, linking each random variables you could have in terms of dependence/independence.