Extending Dynamic Bayesian Networks in pyAgrum for Multi-Temporal Modeling

**Cahier des Charges - Retro Planning**

**Objective**

The goal of this project is to extend the **pyAgrum** library to support multi-step time windows (e.g., 2, 3, or 4 steps) for Dynamic Bayesian Networks (dBNs). This will involve implementing new functions for multi-temporal dependencies, as well as enhancing visualization and inference capabilities.

**Key Deadlines**

* + **Submission Deadline:** May 9, 2025
  + **Presentation Date:** May 15, 2025

**Phases & Tasks**

1. **Modelization (Multi-Temporal Dependencies)**
   * **Goal:** Complete the modelization part to support multi-step time windows.
   * **Tasks:**
     + - Implement a function similar to AddArc that takes a time window parameter and adds variables from this window.
       - Implement a function similar to fill\_with that fills the Conditional Probability Table (CPT) by considering variables from the time window.
       - Create a function similar to is2TBN, but for general **p** time steps (instead of just 2).
       - Continue working on the **visualization** of multi-temporal dependencies. This task will be explored in more detail next week.
       - multi-dimensional?
2. **Inference (Non-Optimized)**
   * **Goal:** Implement the inference mechanism without optimization.
   * **Tasks:** Once the modelization part is completed, shift focus to developing inference capabilities.
3. **Structure Learning (if Time Permits)**
   * **Goal:** If there is sufficient time after completing the modelization and inference tasks, explore and implement structure learning for dynamic Bayesian networks.
4. **Unit Testing and Report Writing**
   * **Goal:** Ensure that all functionalities are thoroughly tested and documented.
   * **Tasks:**
     + - Develop **unit tests** for all newly implemented functions.
       - Begin drafting the **report** on the project, documenting the methodology, results, and conclusions.

**Additional Notes**

We will revisit the visualization and inference details as we progress with the cahier des charges, ensuring that these components are aligned with the extended functionalities of the model.

We have 12 weeks :

Cahier des charges : 2 weeks

Modelisation (including tests and docs) : 3 weeks

Inference : 3 weeks

Finalizing the project : 1 week

Check with the prof !