E.A.6.13 (Wumpus)

1.1 Modelling

Given the knowledge abut the **Wumpus world**, and R, C respectively the number of rows and columns of the grid and T the current turn let
- $\mathcal{T} = \{1, ..., T\}$
- $\mathcal{D} = \{N, E, S, W\}$
- $\mathbf{P} = \{1, ..., R\} \times \{1, ..., C\}$ the set of rooms

$$\begin{aligned} \mathrm{LP} = & \left\{S_\rho \mid \rho \in \mathbf{P}\right\} \cup \left\{W_\rho \mid \rho \in \mathbf{P}\right\} \cup \\ & \left\{G_\rho \mid \rho \in \mathbf{P}\right\} \cup \left\{P_\rho \mid \rho \in \mathbf{P}\right\} \cup \\ & \left\{\mathrm{Stench}_\rho \mid \rho \in \mathbf{P}\right\} \cup \left\{\mathrm{Glitter}_\rho \mid \rho \in \mathbf{P}\right\} \cup \\ & \left\{\mathrm{Breeze}_\rho \mid \rho \in \mathbf{P}\right\} \cup \\ & \{\mathrm{Stench}^t \mid t \in \mathcal{T}\} \cup \{\mathrm{Glitter}^t \mid t \in \mathcal{T}\} \cup \\ & \{\mathrm{Breeze}^t \mid t \in \mathcal{T}\} \cup \end{aligned} \tag{1}$$

Let $\rho = (row, col)$ indicate the room in row row and column col of the grid, and let's assume the rooms are ordered lexicografically by row and column.
- S_ρ is true if room ρ is **safe**
- W_ρ is true if room ρ has the **Wumpus**
- G_ρ is true if room ρ has **gold**
- P_ρ is true if room ρ has a **pit**

The **Wumpus world** can be modelle through a series of constraints

$$\begin{aligned} \phi = & \phi_{\mathrm{ALO\_Wumpus}} \wedge \phi_{\mathrm{AMO\_Wumpus}} \wedge \\ & \phi_{\mathrm{ALO\_Gold}} \wedge \phi_{\mathrm{AMO\_Gold}} \wedge \\ & \phi_{\mathrm{Stench\_1}} \wedge \phi_{\mathrm{Stench\_2}} \wedge \\ & \phi_{\mathrm{Glitter\_1}} \wedge \phi_{\mathrm{Glitter\_2}} \wedge \\ & \phi_{\mathrm{Breeze\_1}} \wedge \phi_{\mathrm{Breeze\_2}} \wedge \\ & \phi_{\mathrm{Other}} \cdots \\ & \phi_{\mathrm{Other}} \cdots \end{aligned} \tag{2}$$

(ALO) There is at least one room with the Wumpus

$$\phi_{\mathrm{ALO\_Wumpus}} = \bigvee_{\rho \in \mathbf{P}} W_\rho \tag{3}$$

(AMO) There is at most one room with the Wumpus

$$\phi_{\text{AMO\_Wumpus}} = \bigwedge_{\substack{\rho,\rho' \in \mathbf{P} \\ \rho < \rho'}} W_\rho \to \neg W_{\rho'} \tag{4}$$

(ALO) There is at least one room with the Gold

$$\phi_{\text{ALO\_Gold}} = \bigvee_{\rho \in \mathbf{P}} G_\rho \tag{5}$$

(AMO) There is at most one room with the Gold

$$\phi_{\text{AMO\_Gold}} = \bigwedge_{\substack{\rho,\rho' \in \mathbf{P} \\ \rho < \rho'}} G_\rho \to \neg G_{\rho'} \tag{6}$$