

E.A.6.13 (Wumpus)

1.1 Modelling

Given the knowledge about the **Wumpus world**, and R , C respectively the number of rows and columns of the grid and T the current turn let

- $\mathcal{T} = \{1, \dots, T\}$
- $\mathcal{D} = \{N, E, S, W\}$
- $\mathbf{P} = \{1, \dots, R\} \times \{1, \dots, C\}$ the set of rooms

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

Let $\rho = (\text{row}, \text{col})$ indicate the room in row row and column col of the grid, and let's assume the rooms are ordered lexicographically 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

$$\begin{aligned}
 \phi = & \phi_{\text{ALO_Wumpus}} \wedge \phi_{\text{AMO_Wumpus}} \wedge \\
 & \phi_{\text{ALO_Gold}} \wedge \phi_{\text{AMO_Gold}} \wedge \\
 & \phi_{\text{Stench_1}} \wedge \phi_{\text{Stench_2}} \wedge \\
 & \phi_{\text{Glitter_1}} \wedge \phi_{\text{Glitter_2}} \wedge \\
 & \phi_{\text{Breeze_1}} \wedge \phi_{\text{Breeze_2}} \wedge \\
 & \phi_{\text{Other} \dots} \\
 & \phi_{\text{Other} \dots}
 \end{aligned} \tag{2}$$

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

$$\phi_{\text{ALO_Wumpus}} = \bigvee_{\rho \in \mathbf{P}} W_\rho \tag{3}$$

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

$$\phi_{\text{AMO_Wumpus}} = \bigwedge_{\substack{\rho, \rho' \in \mathbf{P} \\ \rho < \rho'}} W_{\rho} \rightarrow \neg W_{\rho'} \quad (4)$$

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

$$\phi_{\text{ALO_Gold}} = \bigvee_{\rho \in \mathbf{P}} G_{\rho} \quad (5)$$

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

$$\phi_{\text{AMO_Gold}} = \bigwedge_{\substack{\rho, \rho' \in \mathbf{P} \\ \rho < \rho'}} G_{\rho} \rightarrow \neg G_{\rho'} \quad (6)$$