

# *gz-unitree*: Reinforcement learning en robotique avec validation par moteurs de physique multiples pour le robot *H1v2* d'Unitree

Gwenn Le Bihan <[gwenn.lebihan@etu.inp-n7.fr](mailto:gwenn.lebihan@etu.inp-n7.fr)>

6 Novembre 2025

# **Reinforcement Learning**

## Et son application à la robotique

# Bases du RL

Agent

Environnement

Score

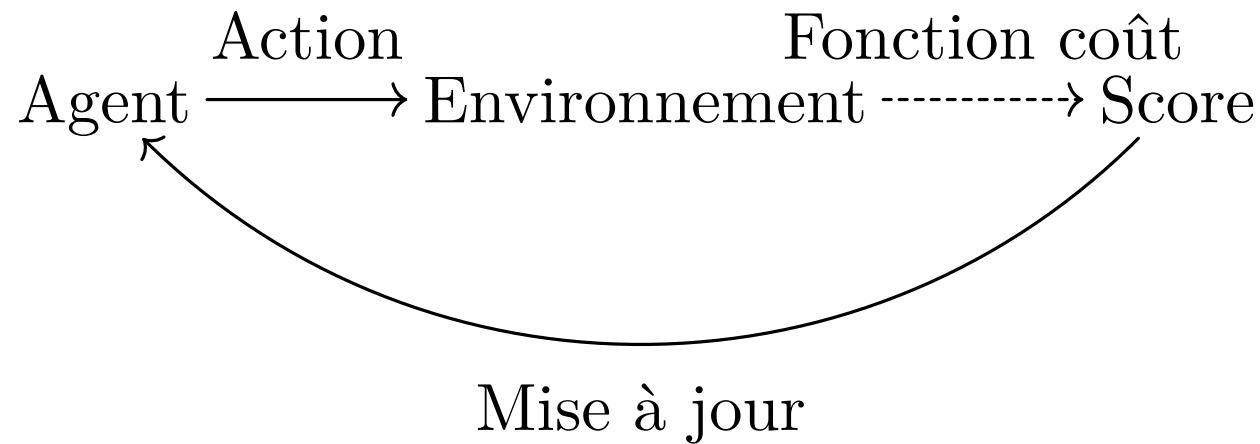
# Bases du RL



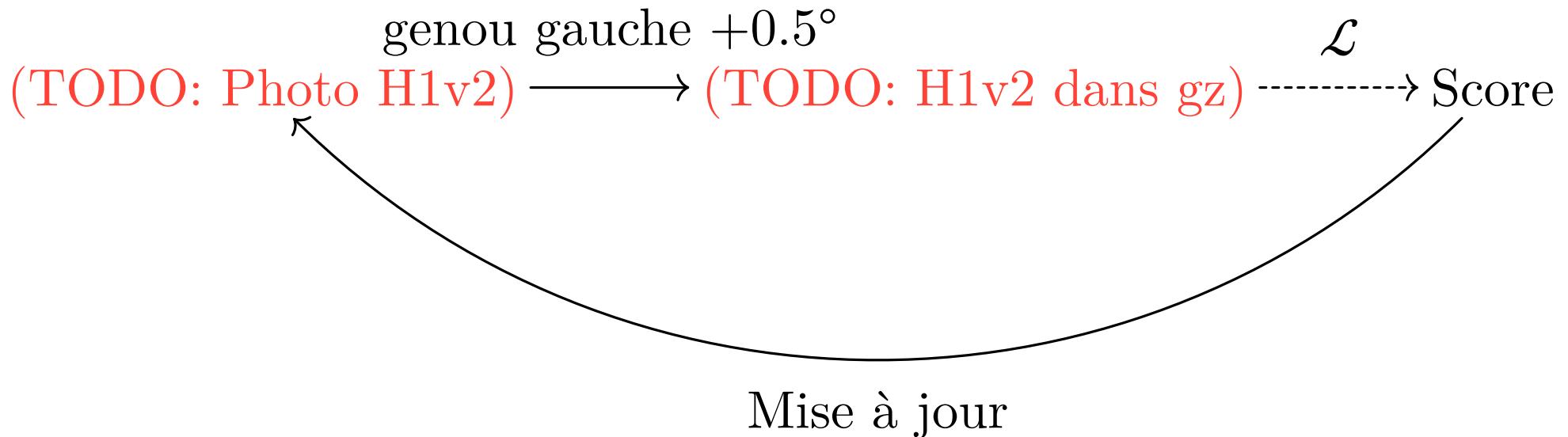
# Bases du RL



# Bases du RL



# RL en robotique



# C'est quoi $\mathcal{L}$ ?

C'est très simple:

$$\mathcal{L}_r(\pi', \pi) := \mathbb{E}_{(s_t, a_t)_{t \in \mathbb{N}} \in \mathcal{C}} \sum_{t=0}^{\infty} \frac{Q_{\pi}(s_t, a_t)}{Q_{\pi'}(s_t, a_t)} A_{\pi, r}(s_t, a_t)$$

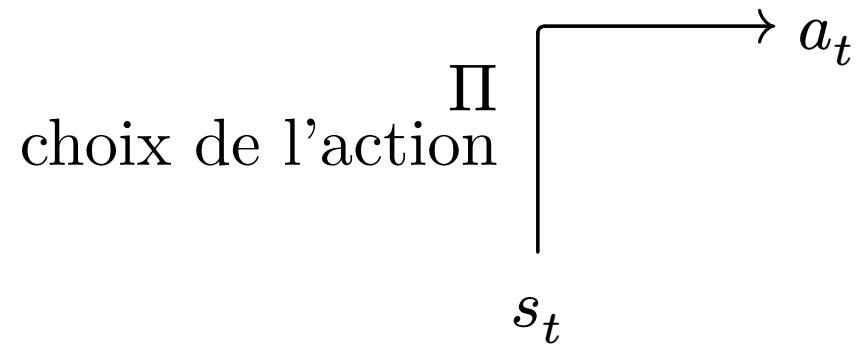
# **Comparaison des politiques**

## En Reinforcement Learning

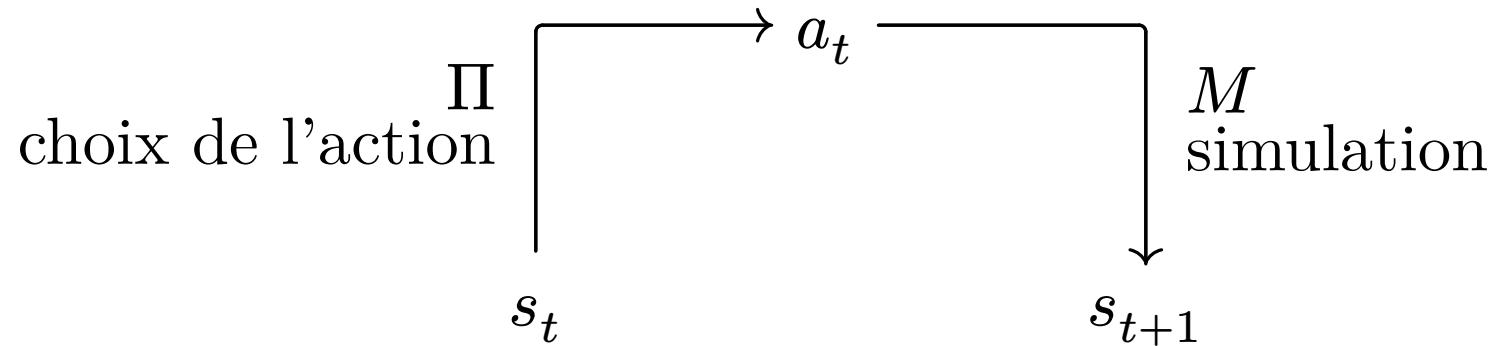
# Comparaison des politiques

$s_t$

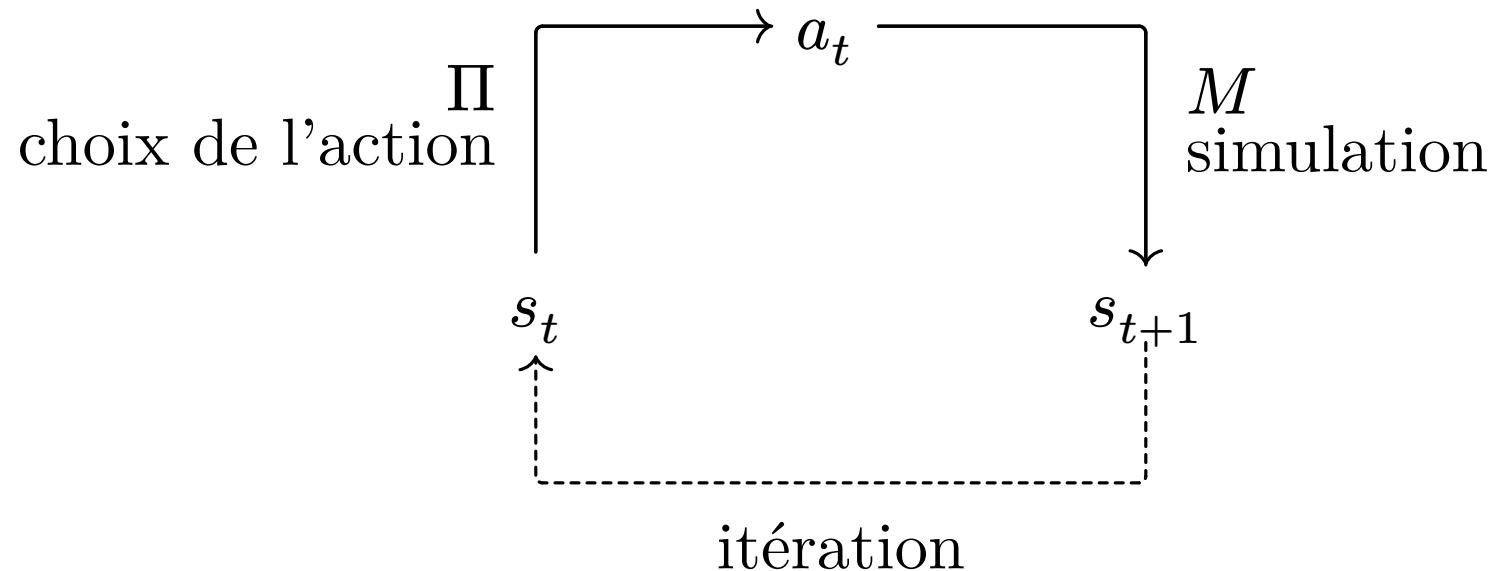
# Comparaison des politiques



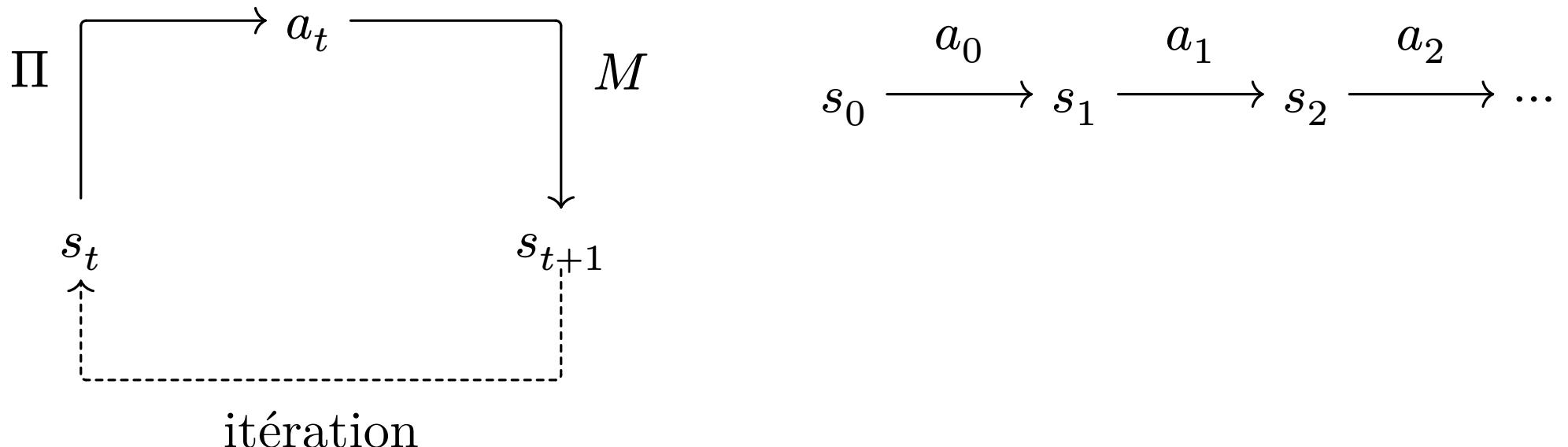
# Comparaison des politiques



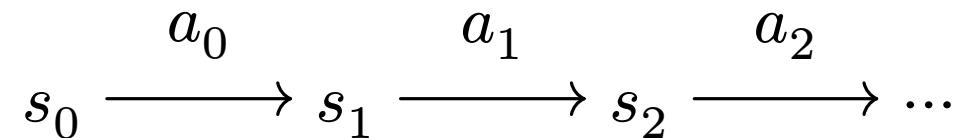
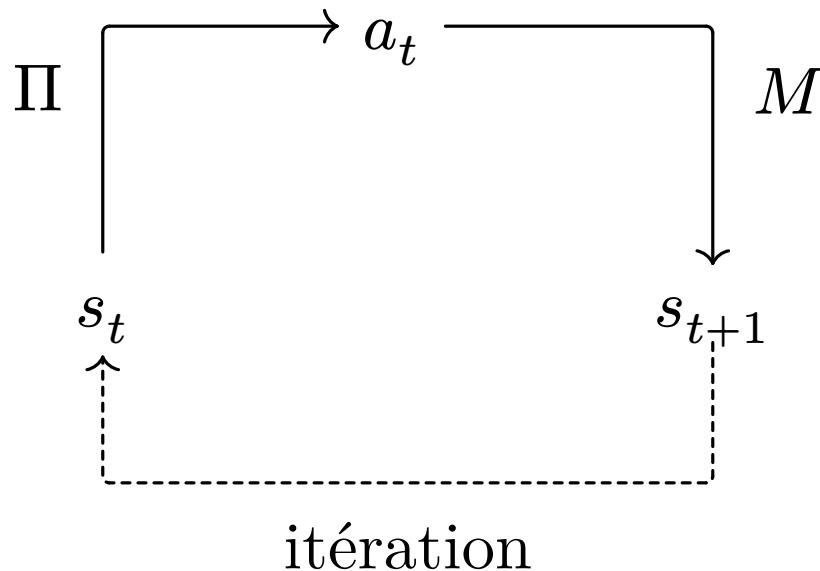
# Comparaison des politiques



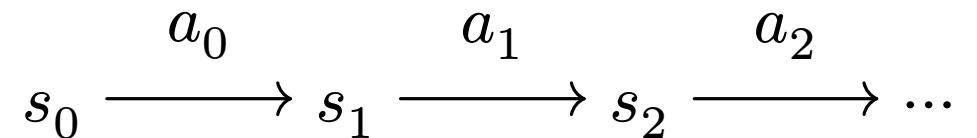
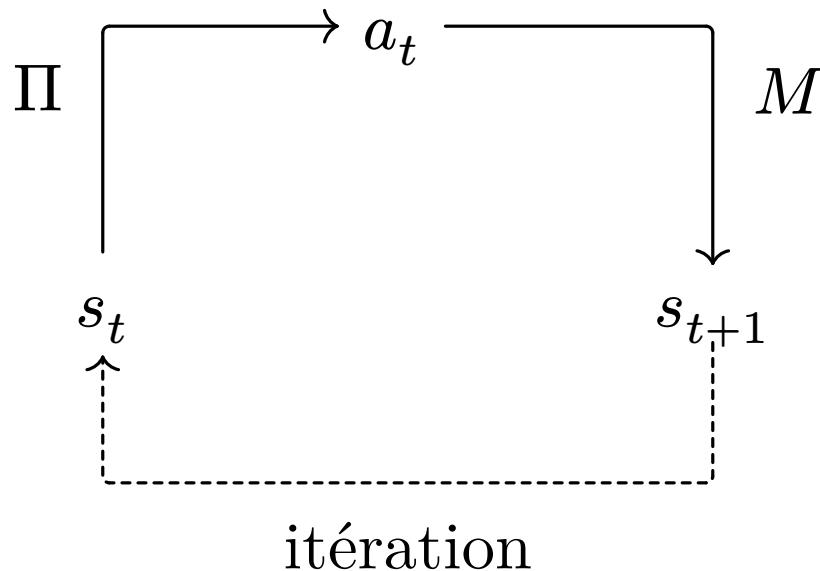
# Comparaison des politiques



# Comparaison des politiques



# Comparaison des politiques



$$((s_0, a_0), (s_1, a_1), (s_2, a_2), \dots) \in \mathcal{C}$$

# Comparaison des politiques

$A$  := actions possibles

$S$  := états possibles

$$\mathcal{C} := \left\{ \left\{ \forall t \in \mathbb{N} \quad \begin{array}{l} c_0 = (s_0, a_0) \\ c_{t+1} = (M(c_t), a_t) \end{array} \right| (s_0, a) \in S \times A^{\mathbb{N}} \right\}$$

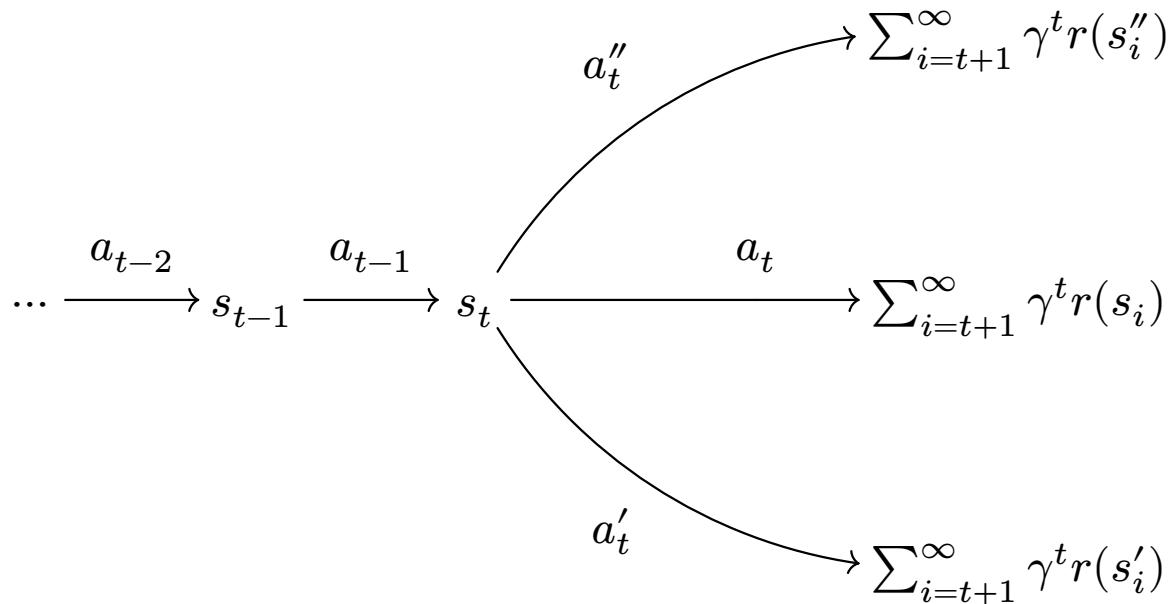
## Comparaison des politiques: Avantage $A$

À quel point est-il mieux de choisir  $a_t$  plutôt qu'une autre action?

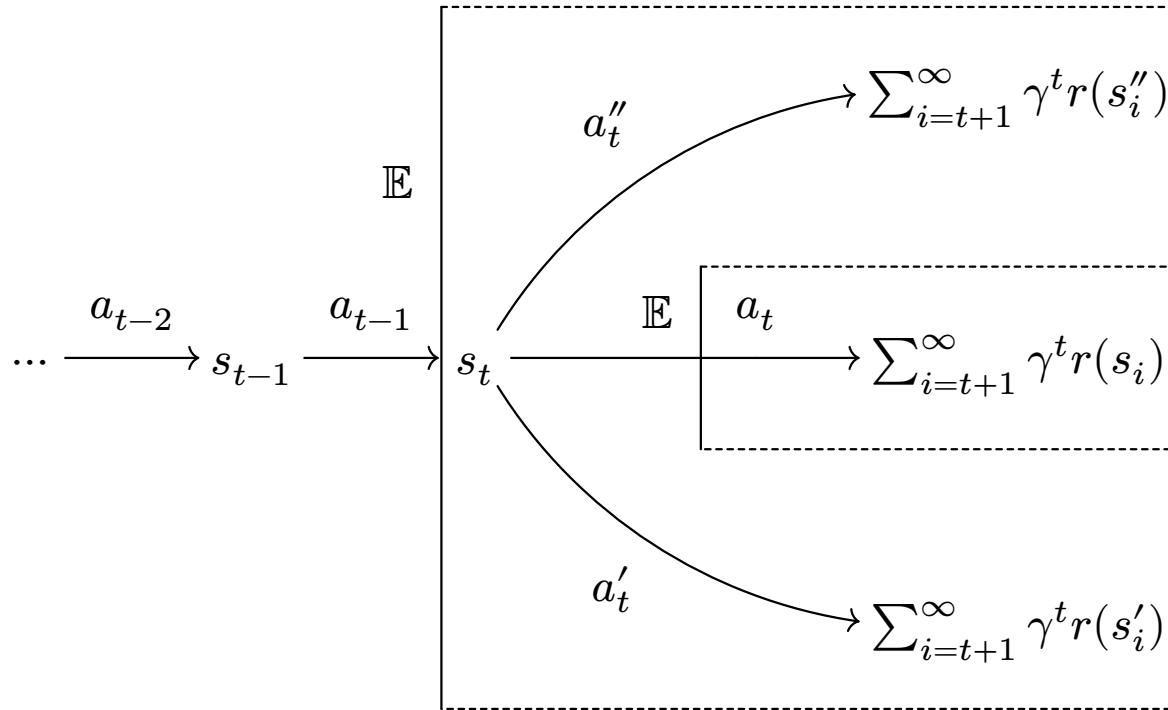
# Comparaison des politiques: Avantage *A*

$$\dots \xrightarrow{a_{t-2}} s_{t-1} \xrightarrow{a_{t-1}}$$

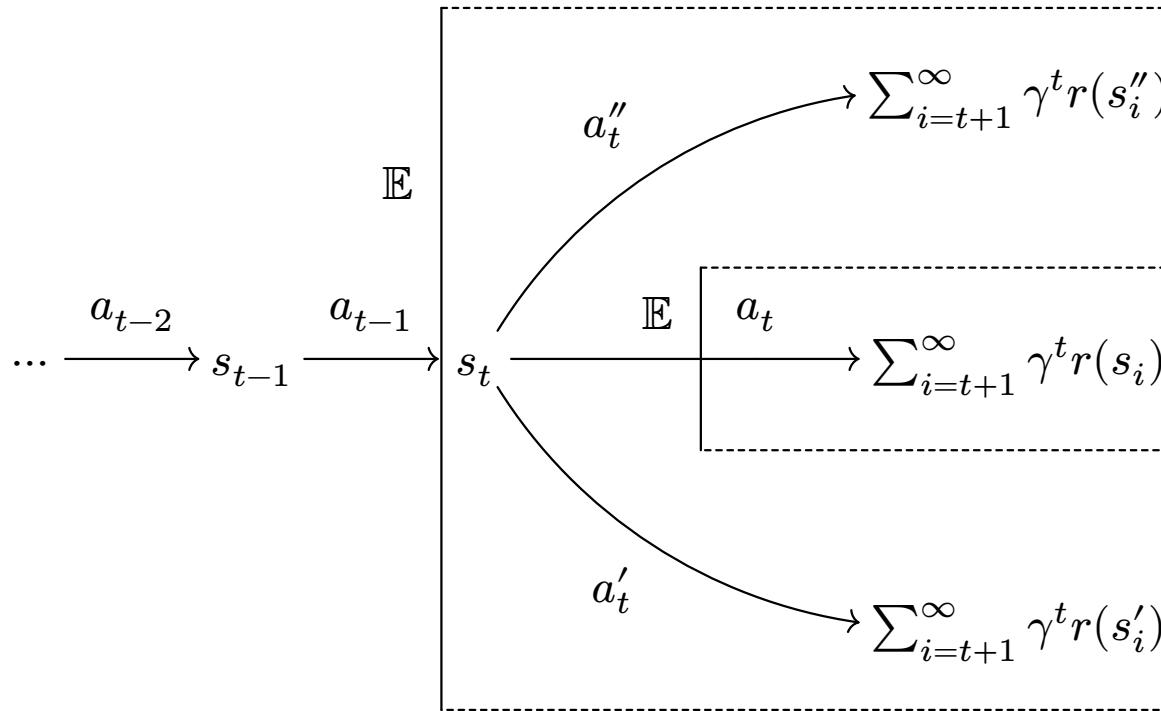
# Comparaison des politiques: Avantage $A$



# Comparaison des politiques: Avantage $A$



# Comparaison des politiques: Avantage $A$



$$A_{\pi,r}(s, a) := \mathbb{E}(\text{avec } a_t) - \mathbb{E}(\text{à } t-1)$$

# C'est quoi $\mathcal{L}$ ?

C'est très simple:

$$\mathcal{L}_r(\pi', \pi) := \mathbb{E}_{(s_t, a_t)_{t \in \mathbb{N}} \in \mathcal{C}} \sum_{t=0}^{\infty} \frac{Q_{\pi}(s_t, a_t)}{Q_{\pi'}(s_t, a_t)} A_{\pi, r}(s_t, a_t)$$