Game Environments

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1 Linear Quadratic Game

Consider n-player dynamic game with state evolution

$$x_{t+1} = Ax_t + B_1 u_{1,t} + \cdots + B_n u_{n,t}$$

and costs

$$c_i(x, u_1, \ldots, u_n) = \sum_{t=0}^{T} x_t^\top Q_i x_t + \sum_{j=1}^{n} u_{j,t}^\top R_{ij} u_{j,t}$$

where $x_t \in \mathbb{R}^{\texttt{n\_state}} = \mathbb{R}^{n_s}$, $u_{i,t} \in \mathbb{R}^{\texttt{n\_action}_i} = \mathbb{R}^{n_{ai}}$, $Q_i \in \mathbb{R}^{n_s \times n_s}$ is symmetric, $R_{ij} \in \mathbb{R}^{n_{aj} \times n_{aj}}$.

For zero-sum games, $n = 2$ and $Q_1 = -Q_2 > 0$, $R_{ij} = -R_{ji} > 0$.

We store $(x_t, u_{1,t}, \cdots, u_{n,t}, x_{t+1})$ state action pairs