

The Curse of Dimensionality

Guillaume Lozenguez

@imt-lille-douai.fr



IMT Lille Douai
École Mines-Télécom
IMT-Université de Lille

With a Classical 32-card game

Possible distribution $32! = 2.6 \times 10^{35}$



Human life: around 5×10^7 seconds

Probability to play 2 times the same distribution in a human life is very close to 0

Decision Making

Is about controlling linked variables:

- ▶ Learning correlation
- ▶ Optimize trajectories

Mathematically:

- ▶ Manipulate Cartesian Product (Set Theory)
- ▶ Estimate functions
- ▶ Exploring large graph

Dealing with large State Space

Reduce the state space

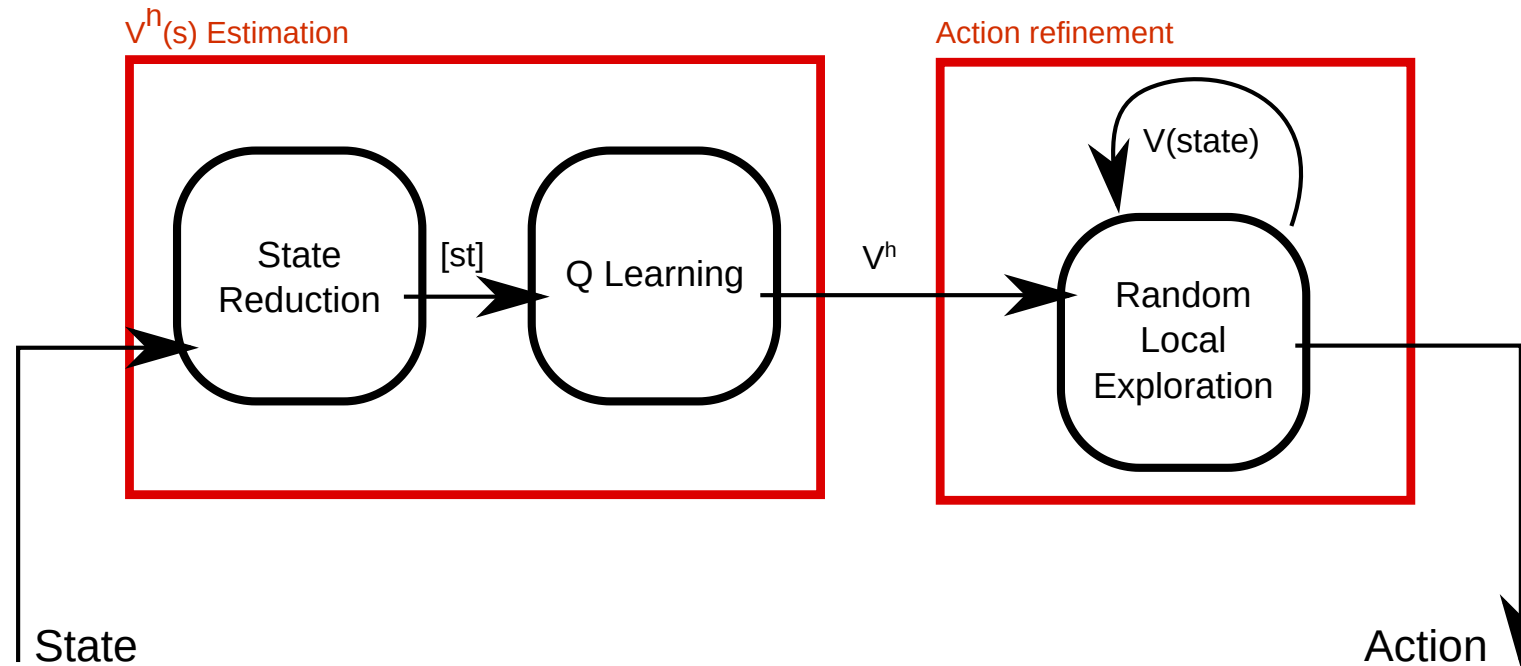
Work locally

A combination of these 2 solutions

A Complete Decision Architecture



A Complete Decision Architecture



State reduction (or identification)

Approach:

Distance based approach:

- ▶ Principal Component Annalysis (**PCA**) (+ Discretization)
- ▶ Clustering: **k-means**, Simple Vector Machine (**SVM**)

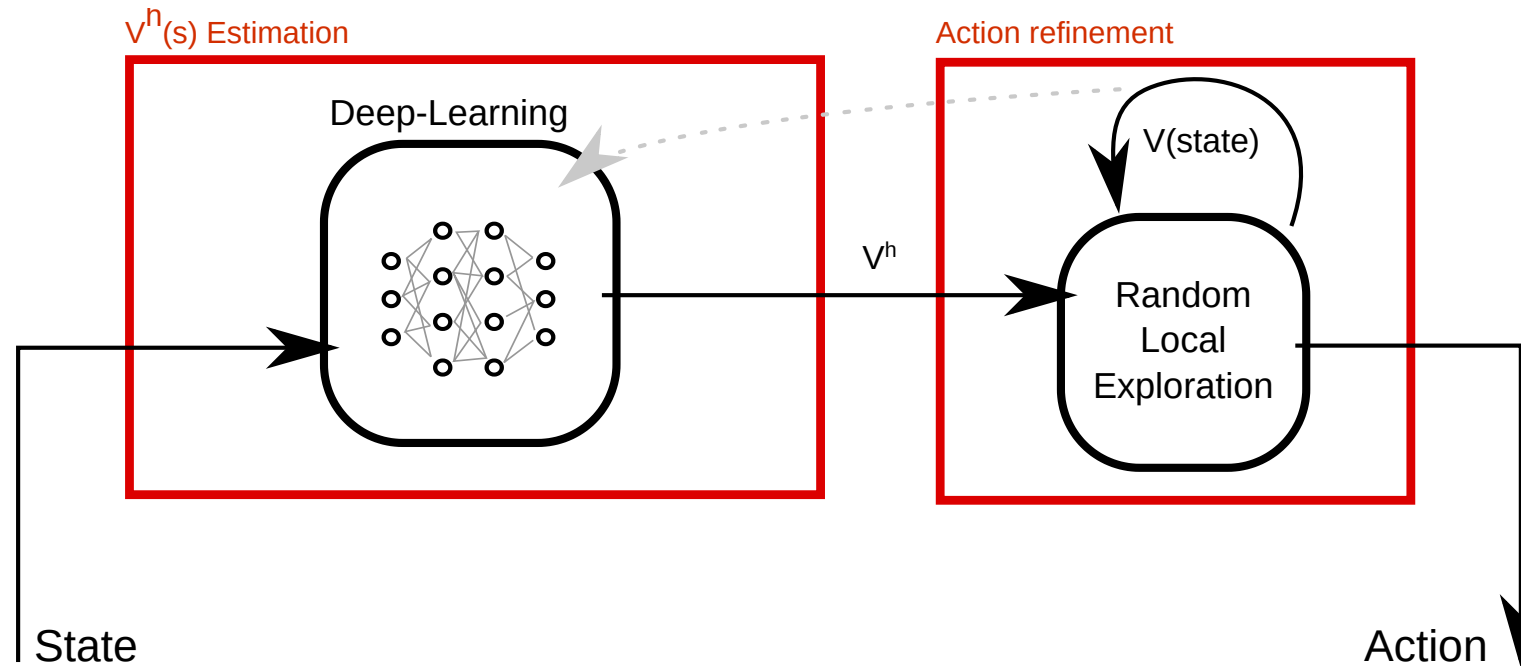
Discrete approach:

- ▶ Decision-Tree (ID3 algorithm family)

Goals:

Macro-States merge states with supposed similar values.

Deep-Learning-based Decision Architecture



Requirement:

Labeled data with valid *values*...

Action refinement at run time

Local computation of the Values and the policy from current state.

- ▶ Constrained Value Iteration (from the current state, with a limited horizon)
- ▶ Monte Carlo Approach (based on deep, but random trajectories)

Requirement:

Simulation: a model of the controlled system