

## Homework exercise 2

### Value function iteration and MPC

Submission deadline: February 5, 2021, 2pm

Please use this sheet to fill in your results and hand it in together with the rest of your solution, i.e. your commented written calculations. Notice that giving only the results will not be credited.

#### Problem 1:

a)

Optimal control problem:

$$\min_u \sum_{k=0}^{\infty} \alpha^k f_0(x_k, u_k)$$

$$\begin{aligned} \text{s.t. } & x_{k+1} = f(x_k, u_k) \\ & x_k \in \mathcal{X} = \{\xi_1, \dots, \xi_8\} \\ & u_k \in \mathcal{U} = \{0, 1, 2\} \\ & x_0 = \xi_1 \end{aligned}$$

Value function iteration:

with a last iteration  $V_{old} = V$ .

$$\begin{aligned} V^{\text{new}}(\xi_1) &= \min_{u \in \mathcal{U}} \{1 + 0.9V(\xi_2), 1 + 0.9V(\xi_2)\} \\ V^{\text{new}}(\xi_2) &= \min_{u \in \mathcal{U}} \{3 + 0.9V(\xi_7), 6 + 0.9V(\xi_5), 3 + 0.9V(\xi_4)\} \\ V^{\text{new}}(\xi_3) &= \min_{u \in \mathcal{U}} \{1 + 0.9V(\xi_4), 2 + 0.9V(\xi_6), 3 + 0.9V(\xi_5)\} \\ V^{\text{new}}(\xi_4) &= \min_{u \in \mathcal{U}} \{2 + 0.9V(\xi_7), 6 + 0.9V(\xi_9), 3 + 0.9V(\xi_6)\} \\ V^{\text{new}}(\xi_5) &= \min_{u \in \mathcal{U}} \{0 + 0.9V(\xi_4), 0 + 0.9V(\xi_4), 1 + 0.9V(\xi_6)\} \\ V^{\text{new}}(\xi_6) &= \min_{u \in \mathcal{U}} \{5 + 0.9V(\xi_7), 2 + 0.9V(\xi_4), 1 + 0.9V(\xi_9)\} \\ V^{\text{new}}(\xi_7) &= \min_{u \in \mathcal{U}} \{2 + 0.9V(\xi_9), 2 + 0.9V(\xi_8), 2 + 0.9V(\xi_9)\} \\ V^{\text{new}}(\xi_8) &= \min_{u \in \mathcal{U}} \{0 + 0.9V(\xi_9), 0 + 0.9V(\xi_9), 0 + 0.9V(\xi_9)\} \end{aligned}$$