Session 5

Relaxed dynamic programming and Q-learning

Reading assignment
Check the main results and examples of these papers.

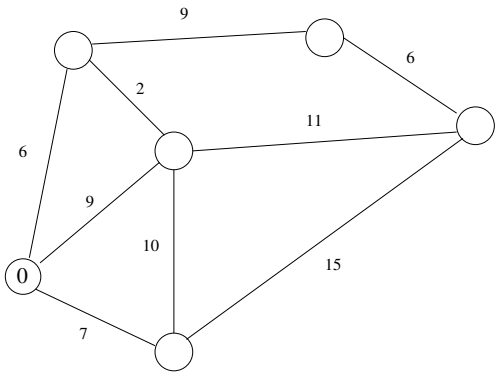
- Lincoln/Rantzer, TAC 51:8 (2006)
- Rantzer, IEE Proc on Control Theory and Appl. 153:5 (2006)
- Geramifard et.al, Found. & Trends in Machine Learn. 6:4 (2013)

Exercise 5.1 Consider the linear quadratic control problem

$$\begin{aligned} &\text{Minimize} && \sum_{t=0}^{\infty} x(t)^2 + u(t)^2 \\ &\text{subject to} && x(t+1) = x(t) + u(t) \qquad x(0) = x_0 \\ & && u(t) \in [-1, 1|. \end{aligned}$$

a. Find a quadratic lower bound on the optimal cost $J^*(x)$. Verify that it satisfies the Bellman inequality for lower bounds.
b. Determine $J^*(x)$ and $Q^*(x,u)$.

Exercise 5.2 For the optimal jump problem illustrated below, run Dijkstra's algorithm to determine the values of J^* and Q^* at the nodes.



Exercise 5.3 From Chapter 4 in [Geramifard et.al (2013)], select one of the benchmarks and do the experiments for
a. one of the Dynamic Programming algorithms.
b. one of the Reinforcement Learning algorithms.
Compare the results.