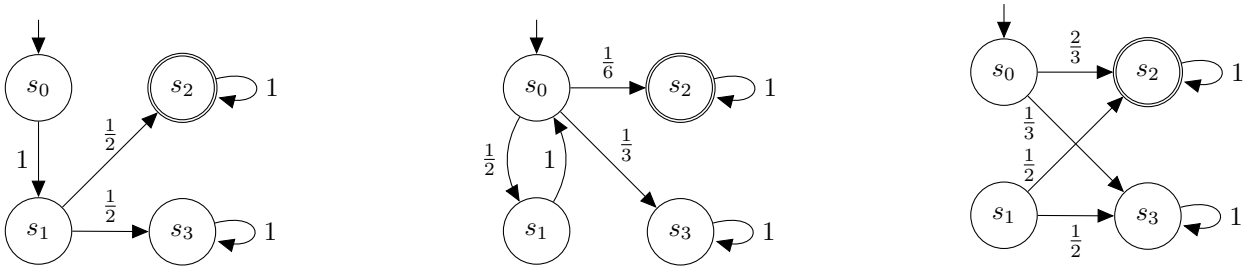
Model Checking: exercise set 9
Parametric Probabilistic Model Checking

Due date: May 8

1. Quotients for Markov chain families

Consider the three Markov chains below, where the numbers identify the states. A target state is indicated by double circles.



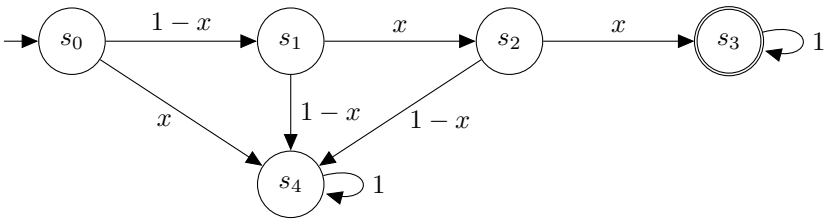
1. What is the reachability probability for these three Markov chains?
2. Construct the quotient MDP.
3. How many memoryless deterministic schedulers do exist in the quotient MDP?
4. What is the maximal reachability probability in the quotient MDP? What is the minimal reachability probability?

2. Parametric Markov chains and well-definedness

1. Can you give a parametric Markov chain that has no well-defined valuations?
2. Can you give a parametric Markov chain that has well-defined valuations, but no graph-preserving (and well-defined) valuations?

3. Parameter Lifting

Consider the following pMC and the regions defined below.



- $R_1 = \{\mathsf{val} \mid \mathsf{val}(x) \in [\frac{1}{2}, \frac{9}{10}]\}$
- $R_2 = \{\mathsf{val} \mid \mathsf{val}(x) \in [\frac{1}{2}, \frac{2}{3}]\}$
- $R_3 = \{\mathsf{val} \mid \mathsf{val}(x) \in [\frac{2}{3}, \frac{9}{10}]\}$

Do the following:

1. Construct the lifted MDPs for the region R_1, R_2, R_3, respectively.
2. What is the maximal reachability probability in each of those MDPs?

4. State elimination

1. Consider the parametric Markov chain from the previous exercise. What is the solution function? What is the maximum of this solution function inside R_1?
2. Perform state elimination and provide the solution function on the following pMC: