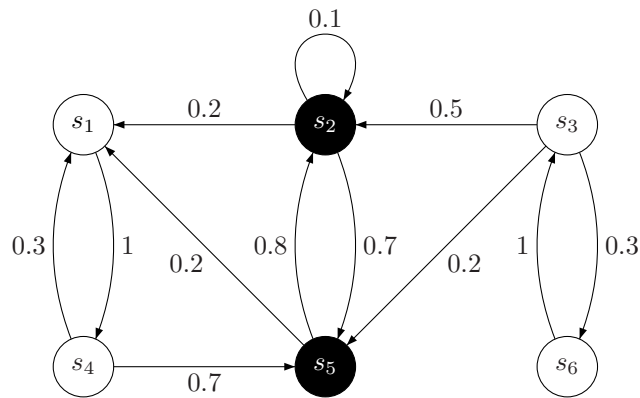# Exercises: Bisimulation

David N. Jansen[*]

Quantitative logics

1. Calculate the bisimulation equivalence quotient of the following Markov chain. $L(s_2) = L(s_5) = \{black\}$ and the other labelling sets are empty.

2. On most Markov chains, we only want to check a few properties. Bisimulation can then be coarsened in three ways:

   (a) Weak bisimulation does not count the number of steps it takes until a given state. Steps that do not lead to a change in the atomic propositions are "invisible". The probability distribution that is relevant for the bisimulation is the one you get when you count the visible steps (or sequences of steps that end with a visible step).

   (b) Bounded bisimulation looks ahead only a given maximal number of steps. So, a state is bisimilar to any other state that has the same behaviour for the given number of steps.

   (c) Measure-driven bisimulation does not look at all labels, but only at a few ones.

   Give an example formula for each of the three cases that can profit from the coarsening!

3. Prove that bisimulation of Markov chains is complete w. r. t. PCTL, i. e. if two states satisfy the same PCTL formulas, then they are bisimilar.

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[*]Radboud Universiteit Nijmegen