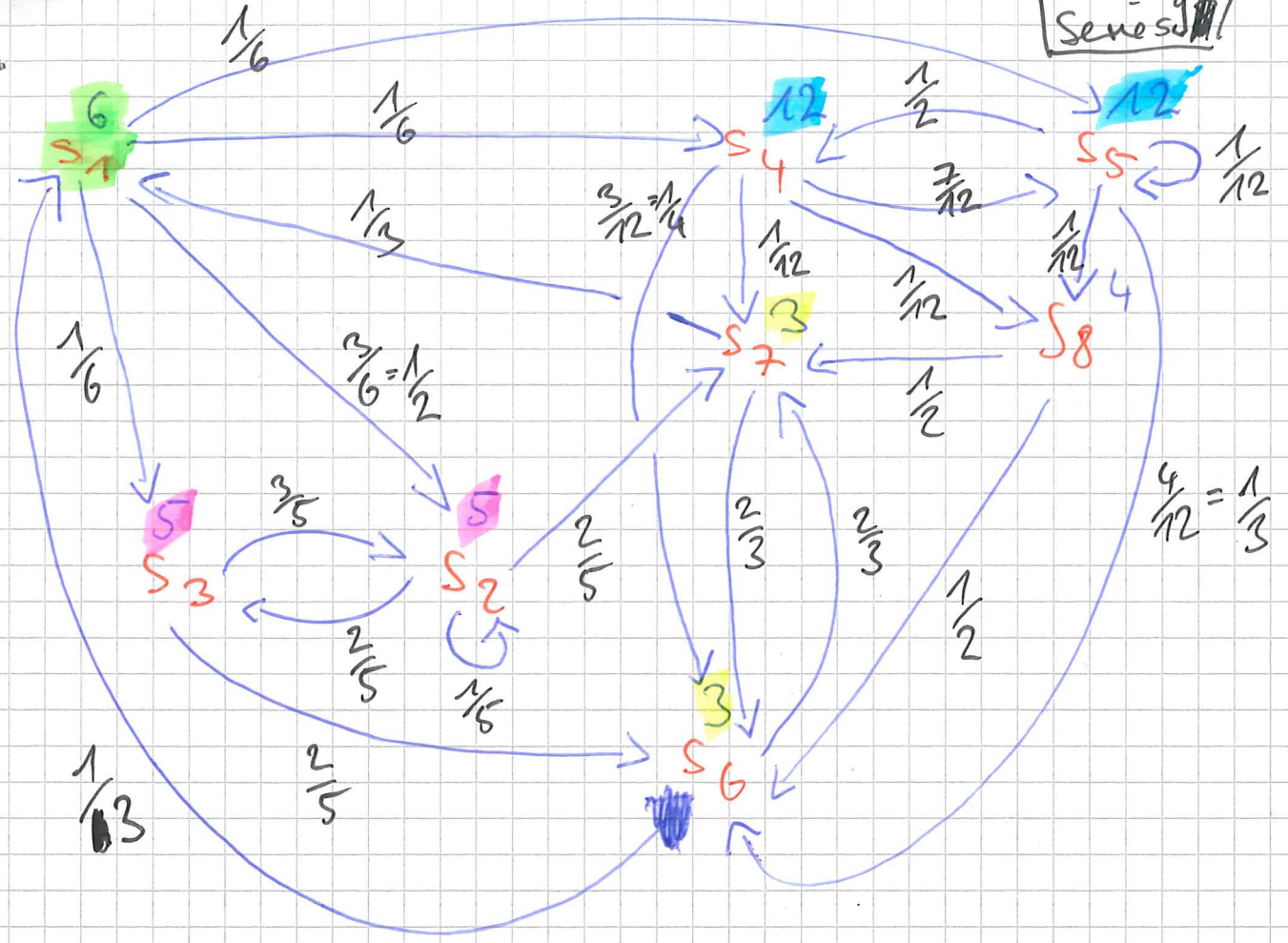
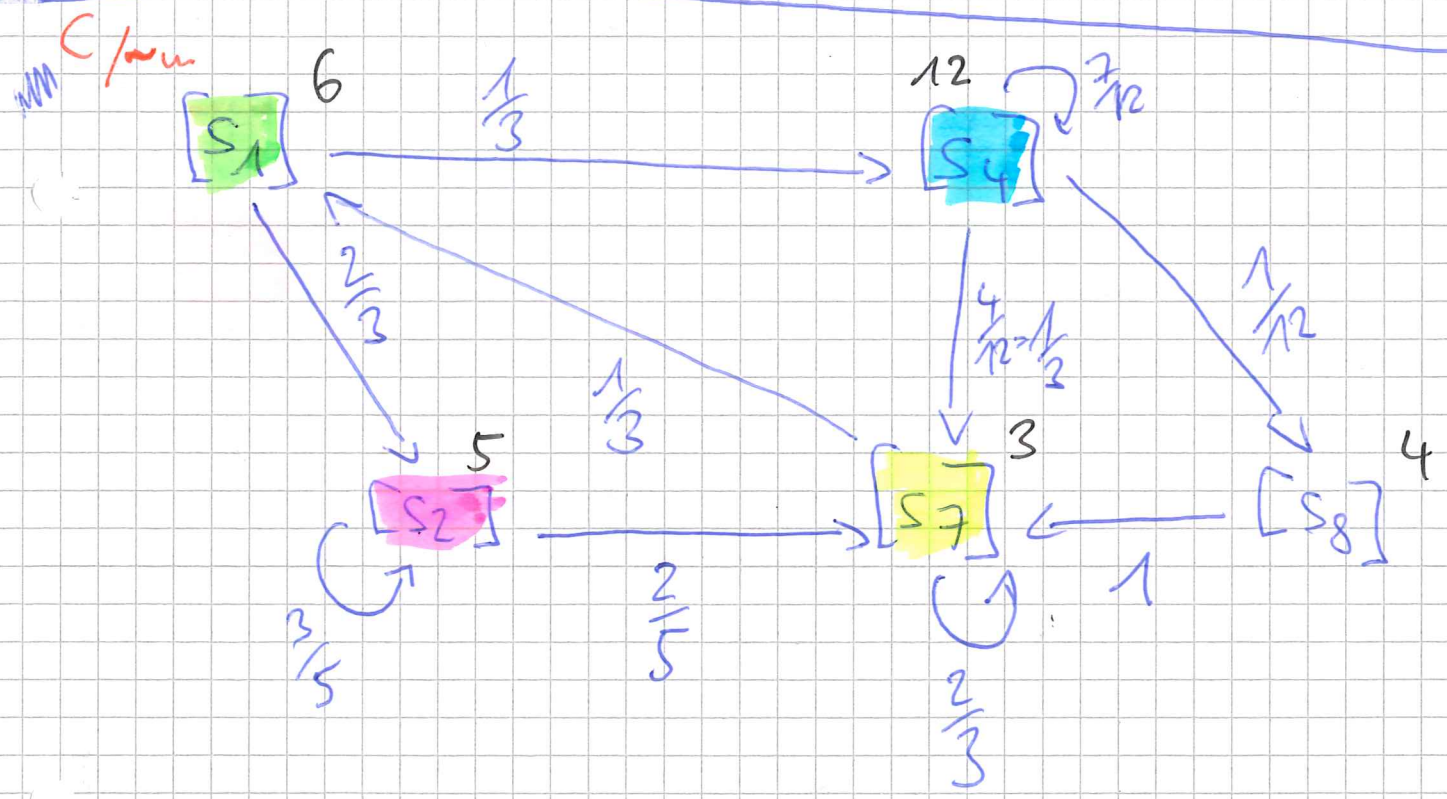


[E1]

[Series 9]

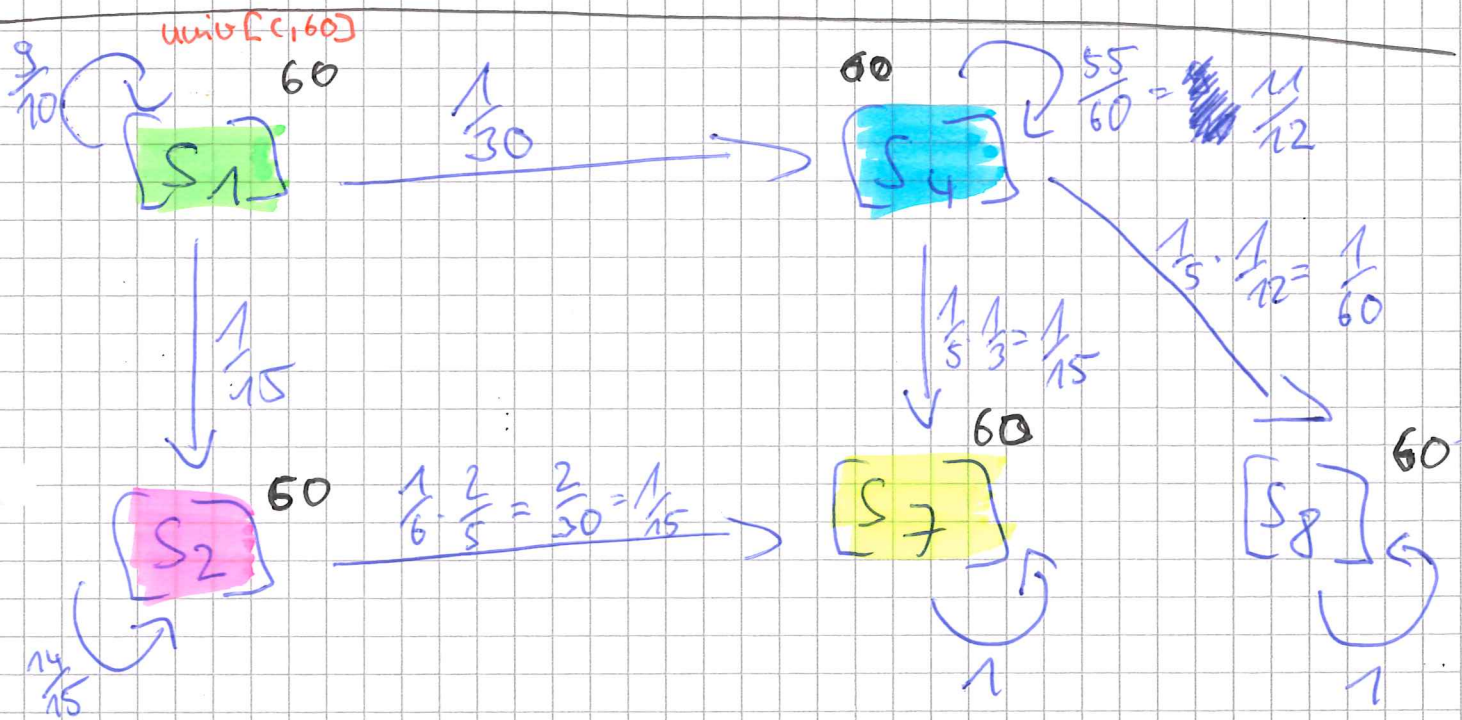
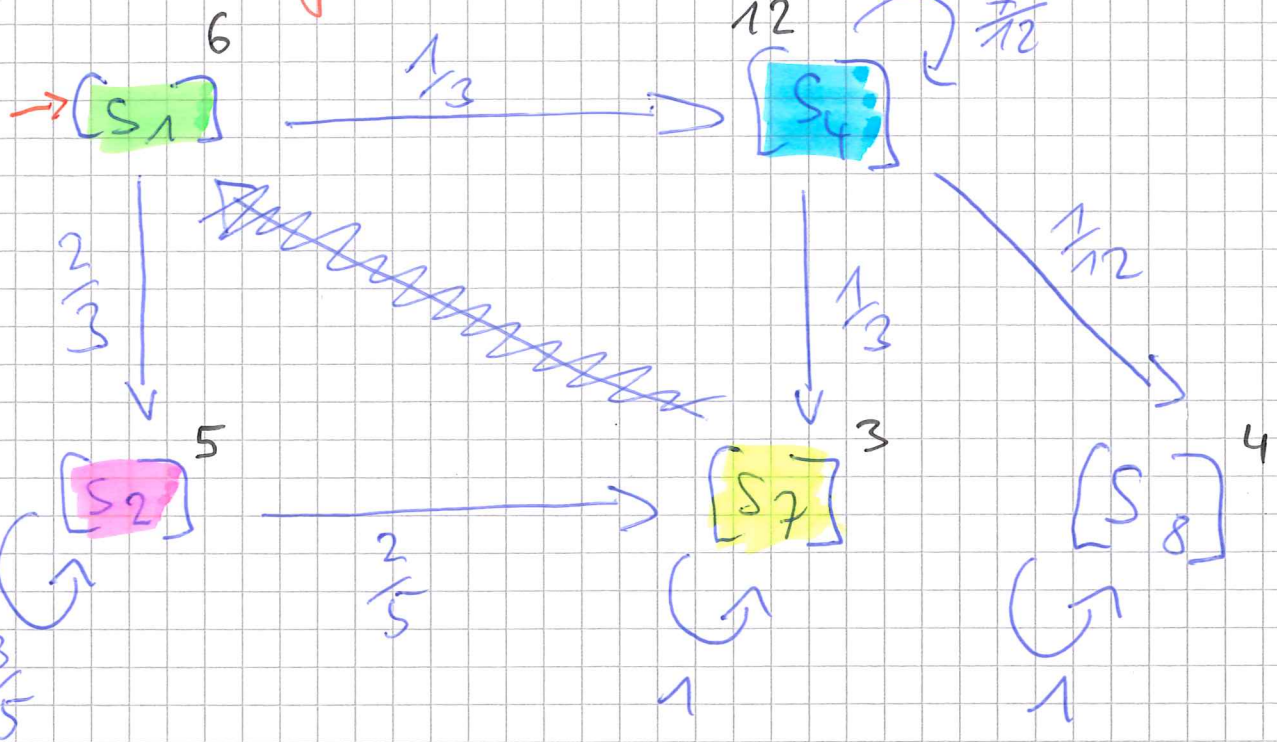


"compute state rates and probabilities"



"simulation quotient"

states absorbing



Uniformization with $\tau = 60$

$$P(S_1, S_4) = \frac{6}{60} \cdot \frac{1}{3} = \frac{1}{30} \quad \left| \quad P(S_1, S_1) = 1 - \frac{6}{60} + 0 \right.$$

$$P(S_1, S_2) = \frac{6}{60} \cdot \frac{2}{3} = \frac{1}{15} \quad \left| \quad = \frac{27}{30} = \frac{9}{10} \right.$$

Computing transient probs:

$$p(0) \cdot \sum_{i=0}^{\infty} e^{-\lambda \cdot t} \cdot \frac{(\lambda \cdot t)^i}{i!} \cdot p^i$$

eingesetzt:

$$\begin{pmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix} \cdot \sum_{i=0}^{\infty} e^{-120} \cdot \left(\frac{120^i}{i!} \right) \cdot \begin{pmatrix} 9/10 & 1/15 & 1/30 & 0 & 0 \\ 0 & 2/15 & 0 & 1/15 & 0 \\ 0 & 0 & 1/12 & 2/15 & 1/60 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

Exercise 2

$$\begin{array}{ccc}
 S & \approx_m & S \\
 \uparrow & & \uparrow \\
 \text{original} & & \text{in uniformized} \\
 \text{CTMC} & & \text{CTMC}
 \end{array}$$

, same holds for u in the original and in the uniformized CTMC

~~On the uniformized CTMC we have~~

So we have:

$$\begin{array}{ccccccc}
 S & \approx_m & S & \sim_m & t & \approx_m & t \\
 \uparrow & & \uparrow & & \uparrow & & \uparrow \\
 \text{unif.} & & \text{orig.} & & \text{orig.} & & \text{unif.}
 \end{array}$$

$$\Rightarrow \begin{array}{ccc}
 S & \approx_m & t \\
 \uparrow & & \uparrow \\
 & \text{unif.} &
 \end{array} \Rightarrow p_s(h) = p_t(h), \text{ i.e.}$$

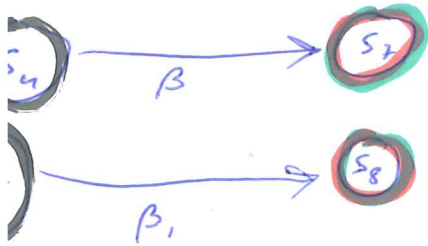
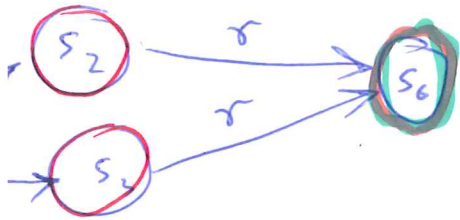
transient probabilities are equal.

Reachability can be expressed as transient prob. QED.

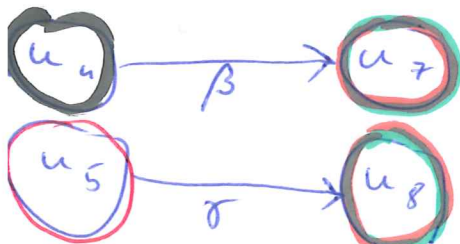
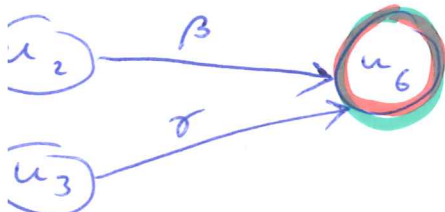
Since we apply biform, the targets have to be closed under biform.

Exercise 3

$$s_0 [0, 2] \quad s_1 [0, 1]$$



$$\mu_3 \triangleq \frac{1}{4} \mu_1 + \frac{3}{4} \mu_2$$



E4 O^I and $\phi \cup^I \psi$ measurable!

case 1: $\ell ::= O^I \phi$

* let $I = [0, t]$.

* $O^I \phi := \{ \pi = s_0, I_0, s_1, \dots \mid s_1 \models \phi \wedge \sup(I_0) \leq t \}$

$= \bigcup \text{cyl}(s_0, I_0, s_1, \dots)$ with $s_1 \models \phi \wedge \sup(I_0) \leq t$

* set of paths $s_0, I_0, s_1, \dots$ countable

* set of rational bounded intervals I_0 countable

$\rightarrow$ countable union of cylinder sets

case 2: $\ell ::= \phi \cup^I \psi$

* let $I = [0, t]$.

* $\phi \cup^I \psi ::= \{ \pi = s_0, I_0, s_1, I_1, \dots \mid \exists t' \leq t. (\forall t'' \in [0, t']). \pi @ t'' \models \phi \wedge \pi @ t' \models \psi \}$

$= \bigcup \text{cyl}(s_0, I_0, s_1, I_1, \dots, s_n)$ with

~~$s_0, I_0, s_1, I_1, \dots, s_n$~~

$\sup(I_0) + \dots + \sup(I_{n-1}) \leq t, s_0, \dots, s_{n-1} \models \phi, s_n \models \psi,$