Ruzica Piskac, Ph.D.
Leander Tentrup, M.Sc.
Michael Gerke, M.Sc.
Felix Klein, B.Sc.

Summer term 2014
Problem Set 3
Due: Tuesday, 27th May 2014

Embedded Systems

Please indicate your **name**, **group number**, and **discussion slot tutor**. Only one submission per group is necessary.

Problem 1: MATLAB / Simulink

Download the Simulink model of the damped harmonic oscillator from the course web page.

(a) Let

$$y_s = \lim_{t\to\infty} y(t);$$
$$t_s(d) = \inf\{t \in \mathbb{R}_0^+ : \ \forall t' \geq t.\ |y(t') - y_s| \leq d\}.$$

Approximate y_s and $t_s(0.2)$ with a precision of 1 (by simulation) for the parameters $k = 10$, $m = 1.2$, $y_0 = 15$, and $R = 0.1$.

Hint: You can increase the precision of your simulation when you select under *Simulation → Configuration Parameters* a *fixed-step* solver and decrease the *Fixed-step size*.

(b) Extend the model such that the suspension $u(t)$ varies with a 0.5Hz cosine with an amplitude of 1. Use the following differential equation:

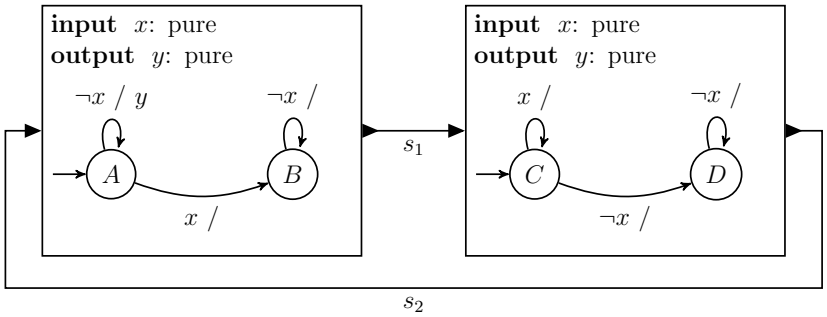
$$\ddot{y}(t) = -\frac{1}{m}\left(k\left(y(t) - \frac{1}{k}u\left(\frac{t}{4}\right)\right) + R\dot{y}(t)\right)$$

In your submission, please provide a print out or a drawing of your Simulink model. State the parameters of all changed or newly added function blocks.

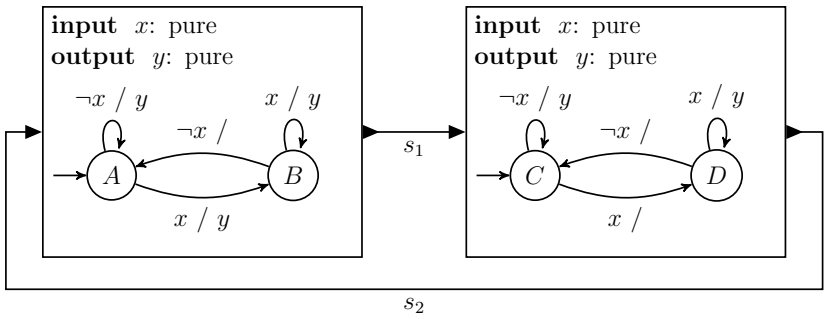
Problem 2: Synchronous Feedback

Consider the following synchronous models and determine whether they are well-formed. If so, give the language of possible sequences of values of the signals s_1 and s_2. If not, give a reachable state that has no or more than one fixed points.

(a)



(b)



Problem 3: Petri Nets warm-up

Draw the Petri net $N = (C, E, F)$ where:

$$C = \{c_1, c_2, c_3, c_4\},$$
$$E = \{e_1, e_2, e_3\},$$
$$F = \{(c_1, e_1), (c_1, e_2), (e_1, c_2), (e_1, c_3), (e_2, c_3), (e_2, c_4), (c_2, e_3), (c_3, e_3), (c_4, e_3), (e_3, c_1)\}.$$

Compute the preconditions of e_3 and the postconditions of e_1. Is N simple? Is N pure? Justify your answers.

Problem 4: Project Reminder

If you have not done yet, start with the project.