Development of Safety-Critical Embedded Systems

WS 2012/2013

Exercise Sheet 1

Please hand in the solutions to the theoretical exercises until the beginning of the next lecture, Fri. 2012-11-09, 10:00. Please write your name as well as the number of your tutorial group and/or the date/time slot on the first sheet of your solution.

Exercise 1.1: Some Simple Scade Functions (Points: 3+3+3)

Implement the following functions in Scade:

(a) A node *Sum*, with two inputs *Val* and *Reset* and one output *Out*. *Out* is the sum of all *Vals* that the node has seen since the last *Reset*. At a reset, *Out* shall be 0.

(b) Define a node *Still*, with one boolean input *X* and one boolean output *Y*. *Y* should be true precisely when *X* has been true all the time since the first point in time.

(c) Define a node *MaxDistance* that expects one boolean input *X* as well as one integer input *N*, and produces a boolean output *OK*. *OK* shall be true in cycle *k*, if and only if *X* was true at least once during the previous *N* + 1 clock cycles or *k* ≤ *N*.

Exercise 1.2: Not So Simple Scade Functions (Points: 6+3)

In this exercise, your task is to provide an implementation of the Taylor series of the sine and cosine functions for a given constant *x* ∈ ℝ:

\[
\sin(x) = \sum_{k=0}^{\infty} \frac{(-1)^k}{(2k+1)!} x^{2k+1} = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \ldots
\]

\[
\cos(x) = \sum_{k=0}^{\infty} \frac{(-1)^k}{(2k)!} x^{2k} = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \ldots
\]

Provide a Scade implementation of a node that produces a sequence of numbers converging to \(\sin(x)\) and \(\cos(x)\), respectively, for a given constant *x*. In your solution, you can introduce auxiliary nodes, but you are only allowed to use the temporal operators *pre*, *when*, and *->*, as well as, addition, subtraction, multiplication, and division.