SAARLAND UNIVERSITY
COMPUTER SCIENCE

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Development of Safety-Critical Embedded Systems
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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 $k \leq N$.

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 $x \in \mathbb{R}$:

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

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

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.