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Summer term 2014
Problem Set 5
Due: Tuesday, 10$^{\text{th}}$ June 2014

Embedded Systems

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

Problem 1: Synchronous Data Flow

Consider the SDF network given in Figure 1, where the initial number of items (or the delay) of the buffer between B and A is 4.
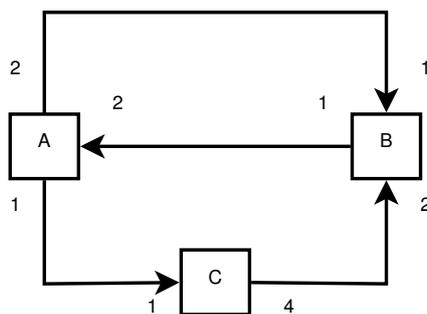

Figure 1: SDF network.

(a) Write down the topology matrix.

(b) Use the matrix to deduce the relative execution rates.
    Write down your intermediate steps!

(c) Determine a periodic schedule.

Problem 2: Synchronous Data Flow

Consider the SDF network given in Figure 2. It shows the signal processing that happens in a voice-band data modem. The delays (initial tokens on transitions) are indicated via the D.

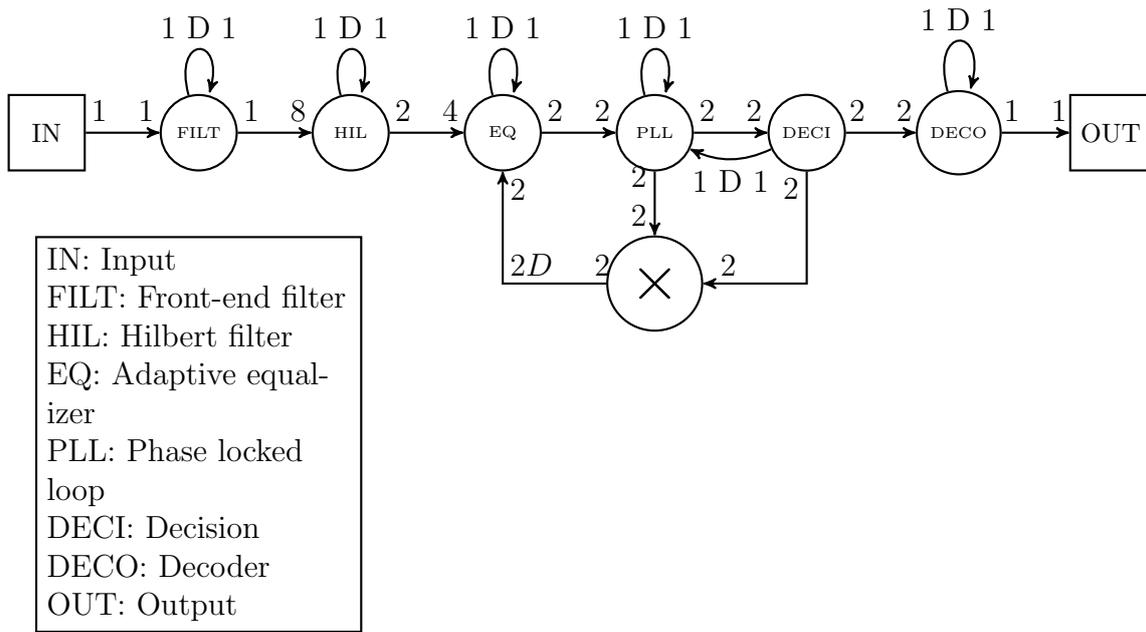Deduce the execution rates for all processes assuming an input frequency of 9.6 kHz.

Figure 2: SDF network for a voice-band data modem.

Problem 3: Kahn Process Networks

Alice owns seven flower shops in different cities. At the end of each month she wants to know the total profit of all stores. So, each shop sends its individual profit in a letter to Alice by mail and she computes the sum as soon as all seven individual profits have arrived.

(a) Model the depicted system as a Kahn process network, where Alice and the seven stores are represented by the processes A, S1, S2, S3, S4, S5, S6, and S7, respectively. The individual profit of store i is represented by the local variable profit(i) which is only accessible by process Si.

(b) Alice is tired of doing all the summation by herself. Luckily for her, each store can not only send but also receive mails by other stores. Therefore, she decides to distribute the computation to the individual stores such that she does not have to perform any addition on her own and each store has to perform at most two addition operations. Here, $x + y$ is one addition operation, $x + y + z$ are two operations, etc.. Assuming that sending a letter always takes one day, Alice wants to receive the total profit within three days. Model an alternative Kahn process network that represents the new communication structure of Alice and her flower shops.

Please specify the process network graphically and the implementation of each process in a C-like syntax using the primitives `<var> = wait(<in>)` and `send(<expr>,<out>)`.