

CS 560 Spring 2008: Homework 3

due Tuesday, March 4

Problem 1 [40 pts]: Consider the system of equations after uniformization/localization for the FIR as given in Equations (19-22) on page 9 of the [LQRR99] reference off the CS560 schedule page. Apply the CoB transformation $(i, j \rightarrow -j, i - j + 3)$ to the variable X , and construct the resulting SRE. Draw the new domain of X , the transformed dependences (your figure should not be overly cluttered, but should have enough detail to see all the different types of dependences). You should use the convention in the lecture notes: origin at the bottom left, i horizontal. [8 pts]

For the following three questions, you will start afresh with SURE (19-22). The transformations are cumulative: you apply a new transformation to the result of the previous one, so be careful since errors will cascade. After each transformation, write the resulting SRE, and draw out only the domain of the variable which is changed. As before, put the origin at bottom left.

- Apply the CoB transformation $(i, j \rightarrow j, i + j - 1)$ to the variable X . [8 pts]
- Apply the CoB transformation $(i, j \rightarrow j, i + j - 1)$ to the variable W . [8 pts]
- Apply the CoB transformation $(i, j \rightarrow j, i + j)$ to the variable Y . [8 pts]

After each of the four transformations above, was the resulting SRE an SARE or SURE? [8 pts]

Problem 2 [60 pts]: You are to systematically derive the array that executes the first pass of the bubble/insertion sort algorithm, for the special case when $N = 2P$ (i.e., when the architecture executes exactly two passes). You will find it convenient to use only P as a single parameter of your equations.

- Write an SURE that describes the computation. The main domain of the two variables involved should be a trapezium where the inputs are along the bottom boundary, and the output is partially on the top and on the right. [10 pts]
- Choose an appropriate schedule, and justify why it is a legal schedule. Choose an allocation function, prove that it does not conflict with the schedule and construct the corresponding CoB transformation. [10 pts]
- Apply the CoB to the SURE to produce the new SURE. [10 pts]
- Draw a neat diagram of the architecture that you obtain at the end. [5 pts]
- Comment on the performance characteristics of the derived architecture: (i) total execution time, (ii) number of processors, (iii) duty cycle of the PEs, (iv) work and efficiency of the architecture. [5 pts]
- Describe at least three other choices for a combination of schedule and/or allocation, and compare the different architectures, based on the four performance metrics above. [20 pts]