University of Toronto, Faculty of Applied Science and Engineering
Department of Electrical and Computer Engineering

ECE 1387 - CAD for Digital Circuit Synthesis and Layout

Exercise #2 – FM Partitioning

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Assignment Date: April 4, 2010
Due Date: April 14, 2010 (at the beginning of class)
Late Penalty: **-1 mark per day late, with total marks available = 10**

The purpose of this exercise is to gain familiarity with Fidducia-Mattheyses (FM) partitioning. You will apply FM partitioning to a set of large/real industrial benchmark circuits. You will investigate the impact of the random seed and balance constraint on partitioning quality. You will also investigate the extent to which hill climbing is helpful in FM partitioning.

Software Location

An implementation of FM is on the course webpage. The implementation is courtesy of the University of Illinois (Chicago) and UCLA. You should be able to type "make" on either of the EECG research networks to build the code.

Manual

A README file is provided with the .tar file containing the C++ code (Note: I altered the output produced by the FM code, so the README file discussion about stats.c is not accurate (and you should ignore it).). The original FM partitioning paper is provided on the course webpage.

Location of Test Circuits

A set of four benchmark circuits is available on the course webpage. These are industrial circuits, courtesy of IBM/UCLA, that are part of the ISPD'98 benchmark suite, an important benchmark suite in placement, routing and partitioning research. You may want to use this suite in your own CAD research and more info can be found at: http://vlsicad.ucsd.edu/UCLAWeb/cheese/ispd98.html

Exercise

1. Run FM five times on each benchmark circuit using five different random seeds and a balance constraint of 0.45 (i.e. no less than 45% of nodes in one of the two partitions). Provide a table showing the average and standard deviation of crossing count (cut size) for each benchmark. State the way in which FM depends on the random seed. Comment on whether FM is sensitive to the random seed.

2. In this step, you will examine the effect of the balance constraint on partitioning quality. Run FM

five times on each benchmark circuit (with different random seeds) for two balance constraints: 0.30 and 0.40. (You should have 10 data points in total for each benchmark circuit.) Provide a table showing the average and standard deviation of crossing count for each benchmark circuit for each balance constraint. Compare your data with that generated for question #1 above. Comment on whether FM is sensitive to the balance constraint.

3. Alter "getprefix" method in the hgraph.cc source file to disable hill climbing in the shuffling step that is executed at the end of each FM pass. Repeat step #1 above with your hacked version of FM. Comment on the extent to which hill climbing affects solution quality in FM.

4. FM is used within the refinement phase of the hMetis multi-level partitioning algorithm. In a few sentences, describe how hMetis uses FM and how FM has been altered within hMetis to improve its run-time.