CAD of Digital Circuits — Physical Design

Spring 2014, Homework # 2
Due Date: Friday, March 7^{th} (in class)
Late assignments will not be accepted

In this assignment, you will implement the Fiduccia-Mattheyses (FM) algorithm using a programming language of your choice. Then you will employ your algorithm to perform a *bi-partitioning* on two hypergraphs. You will also download and run experiments with the hMeTiS tool and compare the quality and run-time results with those obtained by your tool.

1) First, download the hMeTiS tools, the URL is given on the class website. Study the hMeTiS manual and run experiments with the *shmetis* program on the sample S13207P.hgr file. Perform a bi-partition using *UBfactor* = 5, thus allowing for a 45-55 bisection. Study the output and understand the various parameters.
2) Now, you are asked to implement your own version of a FM-style bi-partitioning tool.
   a) You may use any programming/scripting language that you like.
   b) Your tool should take as input the hypergraph given in the *.hgr* format described in the hMeTiS manual. Try to obtain a balance factor similar to the *UBfactor* of 5, generating a bisection within the 45-55 % range.
   c) Run your program on the S13207P.hgr file, and record the cutset and partition sizes, and the run-time.
   d) Your initial partition can be arbitrary, and assume the graph to be unweighted.
   e) You should also execute your program to perform partitioning for the circuit given below. This circuit needs to be represented in the '.hgr' format first, and then apply your algorithm and depict the obtained partitions.

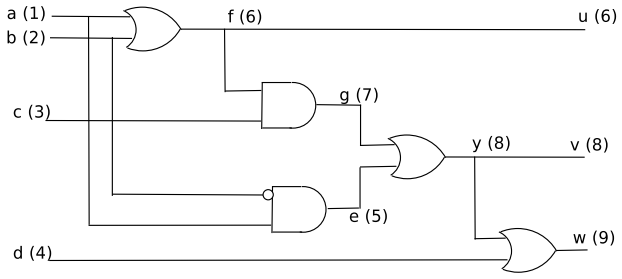

Fig. 1. Partition the circuit using FM. Integer values represent the vertices, and nets should be modeled as hypergraphs.

3) **Submission:** You are then asked to submit a report, approximately 3-4 pages long, double-column, 10-point font. The report should describe:
   a) Brief overview of the FM heuristic, gain functions and balance factors.
   b) Brief description of your implementation, with the algorithm pseudo-code, and your approach to compute and update gain values.

c) The data-structure(s) used to represent the hypergraph, the cut-set, and/or the gain-values and their updates. This is important, because your cell moves will operate on this data-structure. You may refer to the document available at http://www.podload.org/pubs/book/part_survey.pdf to understand the *gain bucket list* data-structure as proposed in the original FM paper.

d) An experiments Table comparing the result of your program and hMeTiS on s13207P.hgr and the circuit.hgr files. [Though not strictly enforced, your program output should be similar to that of hMeTiS: cutset-size, partition size and the list of vertices in each partition.]

4) Do not submit your source-code with the report. Preserve your code, as I *may ask you later* for your implementation and run it on my computer.