**EECS 527: sample exam**

You have 1 hour and 20 minutes to complete your exam.
The exam is open-book.
You must work on all questions individually.

Each question is worth 20 points, but one question will not be graded. You must designate that question by crossing it out (otherwise, it will be determined by rolling a die).

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A. Multiple-choice (circle the right answer) and fill-in-the-blanks

20 pts --- 2 points for each question

True or False?
If a randomized optimization algorithm is used, best of some 3 independent starts may be worse than best of some 4 independent starts.

True or False?
For linear ordering with max-cut minimization, BFS is better than DFS, *and* DFS is better than recursive min-cut bisection.

True or False?
Fixed-outline floorplanning seeks to minimize area.

True or False?
Prim's algorithm for MST runs in linear or near-linear time in the size of the input for dense graphs.

True or False?
Pareto curves for competing algorithms never cross.

True or False?
The runtime of the Kernighan-Lin algorithm for min-cut partitioning may be more than quadratic, but each pass finishes in linear time.

True or False? If gate delays are greater than wire delays, timing-driven placement is *more* important (than if wire delays are greater than gate delays)

The _____ algorithm is typically used for automatic floorplanning.

Name a common floorplan representation _____ .

Name three common design objectives for modern integrated circuits

_____
_____
_____

B. Complexity analysis of partitioning and placement algorithms

20 pts

Give an overall asymptotic worst-case complexity analysis
of linear placement by recursive bisection
implemented with multi-level Fiduccia-Mattheyses partitioning.

You can assume that
- all movables have the same sizes
- one pass of Fiduccia-Mattheyses takes linear time,
- that at every step of clustering the number of clusters
  reduced by a factor of two at least
- the partitioning balance is always limited by 40:60-60:40

You should make (and clearly state) any other assumptions
that are necessary to ensure near-linear complexity.

C. Spatial constraints in top-down placement algorithms.

20 pts

Consider a two-dimensional min-cut MLFM placer.
In order to limit propagation delay in several critical nets,
you are asked to ensure that the bounding box of each of those nets
be limited by given values in the X and the Y direction (two values
per net).

a) Draw a simple example showing that such constraints may be unsatisfiable,
   even when all terminals of constrained nets are movable

b) Suggest at least two different ways of satisfying such constraints
   when they can be easily satisfied (i.e., modify recursive bisection)

c) Can your modifications to recursive bisection *always* satisfy
   net constraints when this is possible? (what happens when the constraints
   become difficult to satisfy?)

D. Timing analysis and timing-driven layout

20 pts

You are given a directed acyclic graph with edge delays (positive floating-point numbers), actual arrival times on sources and required arrival times on sinks.

a) Give pseudocode for finding/printing all nets that lie on paths with negative slack.

b) Give an argument showing that your algorithm runs in linear or near-linear time.

c) How would you use the output of your algorithm to improve the circuit delay during placement ?

E. Floorplanning and macro placement

20 pts

a) Explain the concept of slack in floorplanning and how it is useful.

b) Does it make sense to define slacks when no fixed outline is given?

c) Does it make sense to define slacks when all blocks are L-shaped?

d) If you can change the aspect ratio of blocks to improve the total area, how would you apply such changes?

F. Unrestricted question

Explain why it is useful to perform partial routing during floorplanning.

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