ECE 5460/6460: VLSI Design Automation

Homework 1

Due: 9/15/2022

1. Compare the custom design style and standard-cell design style in terms of the following metrics: design time, flexibility, density. [10 points]

2. The incidence matrix of a directed graph $G = (V, E)$ is a $|V| \times |E|$ matrix $B = b_{ij}$ such that:

$$b_{ij} = \begin{cases} -1; if\ edge\ j\ leaves\ vertex\ i \\ 1; if\ edge\ j\ enters\ vertex\ i \\ 0; otherwise \end{cases}$$

   What do the entries of the matrix product BB^T represent? [30 points]

3. Arrange the following functions in increasing order of complexity, and give reasons for your arrangement. [20 points]

   $n^2 \log n \quad n\log^2 n \quad n \quad 2^n \quad n\sqrt{n} \quad n^{0.5n} \quad n^2 \quad n^{99} \quad n^{\log n}$

4. Express the following in the big-O notation. [20 points]
   a. $4n^2 + 2.5n \log n + 9n + 81$
   b. $0.1n^2 + 10^6 n\sqrt{n}$
   c. $n \log_e n + 99 \log_2 n$
   d. $2^n + e^n$

5. Let $f(n)$ and $g(n)$ be positive functions. Prove or disprove each of the following: [20 points] Hint: Read section A.2.2, page 466 from the book.
   a. $f(n) = O(g(n))$ implies $g(n) = O(f(n))$
   b. $f(n) = O(g(n))$ and $g(n) = O(h(n))$ implies $f(n) = O(h(n))$