

ECE 5460/6460: VLSI Design Automation

Homework 2

Due: 9/29/2022

- (30 points) Sketch transistor-level schematics for the following logic functions. You may assume you have both true and complementary versions of the inputs available.

- (20 points) A 2:4 decoder defined by

$$Y0 = \overline{A0} \bullet \overline{A1}$$

$$Y1 = A0 \bullet \overline{A1}$$

$$Y2 = \overline{A0} \bullet A1$$

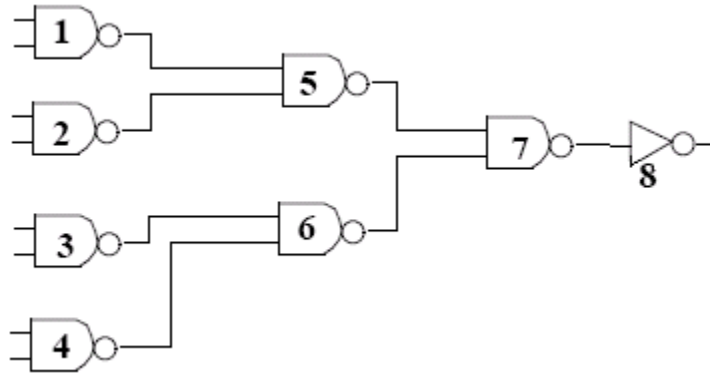
$$Y3 = A0 \bullet A1$$

- (10 points) A 3:2 priority encoder defined by

$$Y0 = \overline{A0} \bullet (A1 + \overline{A2})$$

$$Y1 = \overline{A0} \bullet A1$$

- Apply the K-L algorithm to the circuit below and generate a two-way balanced partition. Assume the initial partition is $A=\{1,2,3,4\}$, and $B=\{5,6,7,8\}$. Does the K-L algorithm generate the optimum in this case? Can you guess the optimum partition for this circuit? [20 points]



- Apply the Fiduccia-Mattheyses heuristic on the following netlist:

$$N1 = \{C4, C5, C6\} \quad N6 = \{C4, C7, C9\} \quad N11 = \{C2, C6, C7\}$$

$$N2 = \{C3, C4, C12\} \quad N7 = \{C2, C8, C10\} \quad N12 = \{C10, C12\}$$

$$N3 = \{C2, C4\} \quad N8 = \{C1, C7\} \quad N13 = \{C4, C7, C12\}$$

$$N4 = \{C3, C7, C8\} \quad N9 = \{C3, C5, C9\} \quad N14 = \{C3, C9, C11\}$$

$$N5 = \{C2, C3, C6\} \quad N10 = \{C6, C8, C11\}$$

- Initially, assume partition $A = \{C1, C2, C3, C4, C5, C6\}$, and partition $B = \{C7, C8, C9, C10, C11, C12\}$. Find the gains of cells $C4$, and $C7$. Give detailed derivations. [6 points]

- b. Suppose now choose $C7$ as the base cell. List the cells whose gain values may be affected by moving $C7$ from partition B to partition A . [2 points]
 - c. Is the balance condition satisfied if all cells have a uniform size = 1 and the tolerance factor $r = 0.5$? [2 points]
 - d. For each of the nets connected to the base cell $C7$, identify the corresponding *free cells*, and discuss how the gains of these free cells should be decremented or incremented after the move of the base cell. [10 points]
- 4. Problem 2.7 from textbook. [20 points]
 - 5. Problem 2.9 from textbook. [10 points]
 - 6. Problem 2.14 from textbook. [10 points]
 - 7. Problem 2.15 from textbook. [20 points]