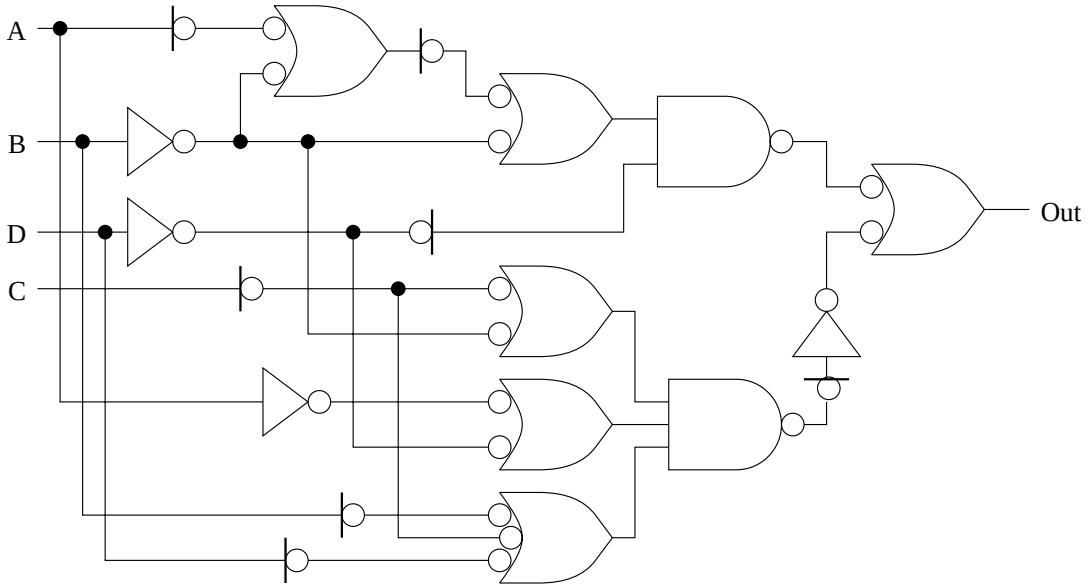
Logic Simplification and Design

Consider the logical function:

$Out = \overline{((\overline{A}+B)+B)\,\overline{D} + (\overline{C}+B)(A+D)(\overline{B}+\overline{C}+\overline{D})}$

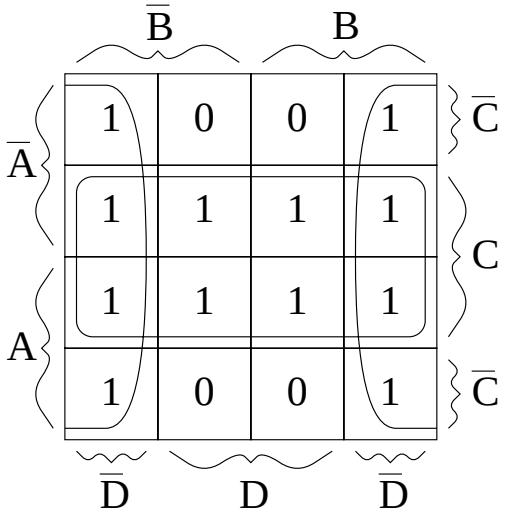
Part A Implement the function using 2-input and 3-input NAND gates and inverters. Use a MIXED LOGIC design methodology. All bubbles must be paired; all bars must be bubbled.



Part B Use DeMorgan's Theorem to obtain an equivalent expression which contains ANDs and ORs of the inputs (e.g., A) and their complements (e.g., $\overline{A}$). There should be **no complements (bars)** in the final expression except those over the inputs. Do **not** simplify the expression for this part.

$Out = (A\,\overline{B}+B)\overline{D} + C\,\overline{B} + \overline{A}\,\overline{D} + B\,C\,D$

Part C Complete the Karnaugh map below and identify the prime implicants. Then write the simplified expression. Be sure the factor out any common terms in your solution.



prime implicant	essential?
C	yes☒ no☐
$\overline{D}$	yes☒ no☐
	yes☐ no☐
	yes☐ no☐
	yes☐ no☐
	yes☐ no☐
	yes☐ no☐

$Out = C + \overline{D}$

Part D Now reimplement the simplified expression from part C using 2-input NAND gates and inverters. Use the MIXED LOGIC design methodology. All bubbles must be paired; all bars must be bubbled.