CS109B Problem Set #5
Due 4:30 PM, Friday 5/19/95

1) (15 points) Compute the truth table for the expression $(p \rightarrow q) \equiv (\texttt{NOT}\ p\ \texttt{OR}\ q)$ and all its subexpressions. (Exercise 12.4.2(a), FCS) Note that `NOT` takes precedence over `OR`, so `NOT` p is grouped first.

2) (20 points) A function $f(p,q)$ is *commutative* if $f(p,q) = f(q,p)$ for all p and q. Find all the logical functions of two variables that are commutative. (Exercise 12.4.6,FCS) You may use the notation of the May 10 notes, where a such functions were represented by 4 bits $wxyz$. However, indicate the common names of those functions that have common names (e.g., `AND` is one of the commutative functions).

3) (15 points) Draw the Karnaugh map for the function that is true if up to two of p, q, r, and s are true, but not if 3 or 4 of these variables are true. Then, list all the prime implicants and select a sum of prime implicants that covers all the 1's of your map. (Exercise 12.6.1(b), 12.6.2(b), FCS)

4) (20 points) How many 1×2 rectangles are there on a Karnaugh map with variables p, q, r, and s? Describe the corresponding implicants in terms of these variables. You need not list them all; just give a rule for telling what they are. (Exercise 12.6.6(a), FCS)

5) (15 points) Is the expression $\big((p \rightarrow q)(q \rightarrow r)\big) \rightarrow (p \rightarrow r)$ a tautology? Prove or give a counterexample. (Exercise 12.7.1(b), FCS)

6) (15 points) Apply DeMorgan's laws to turn the expression $\texttt{NOT}\ (pq + \bar{p}r)$ into one where `NOT`'s are applied only to propositional variables. (Exercise 12.8.6(a), FCS)