COSC-175: Systems-I
Spring 2026
Sample mid-term questions

1. **Demonstrate that NOR is a universal operator**. That is, show that AND, OR, and NOT can all be expressed and implemented using nothing but the NOR operator.

2. Consider the logic function described by the following truth table:

A	B	C	D	Y
0	0	0	0	0
0	0	0	1	1
0	0	1	0	0
0	0	1	1	1
0	1	0	0	1
0	1	0	1	0
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	0
1	1	1	1	0

   Produce a simplified version of this logic function by using a *Karnaugh map*.

3. **Show the design of a *comparitor circuit*.** That is, assuming two 4-bit inputs, $A = (A_3, A_2, A_1, A_0)$ and $B = (B_3, B_2, B_1, B_0)$, generate three 1-bit outputs that represent, respectively, $A < B$, $A > B$, and $A = B$. Assume that the input values are two's complement integers. Show the logic and the circuit that implements it. You may use individual gates as well as high-level components such as adders, multiplexers, etc., as needed.